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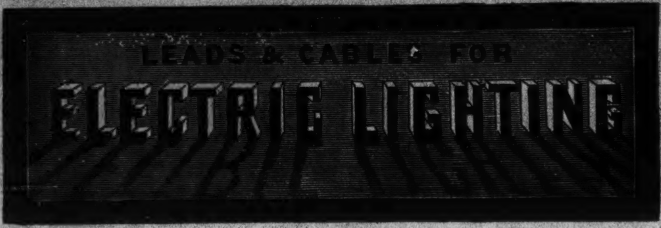

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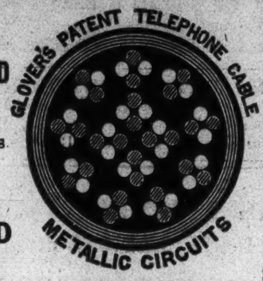

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THE ENGINEER AS A GENTLEMAN AND A SCHOLAR.

WHILE everything, more or less, in England is suffering seriously from a constant levelling-down process by which the social and political status of all classes is being gradually assimilated, which day by day places classical education further in the background, with a consequent grievous loss to the community of all the instructive lessons of honour and self-sacrifice that are to be culled from a study of ancient literature; while the slipshod method of the pronunciation of our mother tongue, in vogue during these latter days, is taken by our lexicographers as correct, and is giving hope and encouragement to the phonographers in their endeavours to mutilate and disfigure the orthography of the English language; while our strenuous attempt to universalise primary education has produced the terrible and expensive School Board machines, which turn out periodically, and in ever-increasing numbers, their scholars—forfend the word—than whom a more ignorant and ill-conditioned set of British cubs could scarcely be found throughout Christendom; youths who, with the exception of those sufficiently controlled by the influence of their parents, may not inaptly be described in the words of the Frenchman who, returning from his travels among savage island tribes, pithily summed up the character of the natives by remarking that "their customs were disgusting and their manners none;" and while we are apparently becoming more and more slaves to the faddists, and that class of people whose sole object—as declared by Oliver Cromwell—is to overturn every existing institution and substitute some untried or chaotic scheme, it is with pleasure we note the first glimpse of reaction, even though it comes from America and does not originate in our own land. It will at some future time, doubtless, spread from thence, and exert some good influence in this country.

The first sign of improvement is manifested in Boston, where the people of culture have discovered that it would be possible to pronounce the English language in a better manner than is usually accomplished by Americans, and it is proposed to form societies to endeavour to remedy the evil. After this, we may reasonably consider it to be within the range of probability that an Edinburgh Scotsman will acknowledge—in a century or two at the latest—that his pronunciation of English may be capable of amendment. Another protest against this retrogression in keeping up a high standard in those things which tend to a higher social life comes from Mr. Oberlin Smith, last year President of the American Society of Mechanical Engineers, who in his Address to the Society chose for his subject, "The Engineer as a Gentleman and a Scholar," in place of the usual *résumé* of the year's doings. A modern engineer, if worthy of the name, must, to a certain extent, be a scholar in many important points of knowledge; but in too many cases young men may be faithful students and earnest workers in the field of pure science to the total ignoring of polite literature, and the cultivation of those qualities which add to the amenities of social intercourse, and which will enable them, as educated men of the world, to meet man anywhere, of any degree, upon their own ground.

Here is Mr. Smith's advice on training for the profession of an engineer : Let the groundwork be a thorough English common school education with as much of the classics or modern languages as the time and circumstance will permit. Then proceed to a technical college, the larger and more fully equipped the better. Adapt the course of study to the branch of engineering which the student intends to follow, bringing in as much of the classics as he can without hampering his science. If his time is limited, let him study German, French, Latin, Greek, in the order named, unless for local reasons Spanish or Italian may be more useful. If the college course does not include ample practical work in field, shop, or laboratory, take care to have some four years of such work before starting as a practising engineer. Besides this, do not neglect a commercial education, if possible spending some time in a counting house to become acquainted with accounts and commercial law. In these days an engineer must be a man of affairs as well as a scientist. Beyond this, let it be strongly impressed that it is of the utmost consequence to write and speak the English language correctly, and to have a fair knowledge of general literature and something of the Shibboleth of civilised society.

A student who follows these instructions cannot fail to become somewhat of a scholar, as well as a man of business capacity, which will enable him to fill posts of position with credit to himself and his employers. But although this may be all that is requisite for him from a technical point of view, there is another side in his training that must not be omitted. His endeavour should be, as a member of a noble profession, to raise himself, and assist in raising others, to the highest possible degree, intellectually, morally, physically, and socially ; in fact, to strive to make himself a gentleman in every sense of the word. He will find, even from a merely selfish aspect, that the polish and *savoir vivre* to be gained thereby will stand him in good stead in his professional advancement.

Mr. Smith suggests that training colleges and schools should follow the lines of the Govermental military and naval schools, where attention is paid, not only to the technical course of study and a superabundance of drill and other *systematic* physical culture, but also to instruction and practice in dancing, to dress, and to other social arts which make for refinement.

The ensuing remarks show that their author is possessed of a frame of mind like to a distinguished military officer in Her Majesty's service, who said that had he 50 sons they should all join the army, if only to teach them *esprit de corps* and to dress for dinner. They would be healthy reading for the managers of many of our primary and secondary educational establishments, and might conduce to some improvements in the moral and social finish of their pupils.

"Let our schools throw such a mantle of refinement over each of their young men, as not only to conceal, but to absorb their cubbishness. Make him not alone truthful, temperate, scientific, skilful, business-like, scholarly, but healthy, erect, graceful, socially accomplished, possessing 'manner' as well as manners. Give him a love for moral and physical cleanness—morally a cleanness shining out of soul and mind, and physically one which shall be manifested, not only upon his face and upon his shoes, but shall reach even to the tips of his finger nails. Give him a horror of careless pronunciation and orthography. Teach him that there is raiment fit for the morning, and raiment meet for the evening. Give him a knightly sense of personal honour, such honour as is above all bribe-taking, and it should keep him infinitely above the consideration of such loot, for example, as commission upon material, the sale of which might be affected by his professional opinion thereupon."

We cannot conclude without fully and sincerely endorsing Mr. Oberlin Smith's hope that engineers will compel a reform in the wretched system of expert testimony, wherein two reputable scientific men are paid by interested clients to draw two opposite sets of conclusions from the same premises, *instead of being paid by the court to speak the truth.*

THE EFFICIENCY OF SMALL TRANSFORMERS.

THE efficiency of transformers is a subject about which widely varying statements have been made, and at present none of the methods which are in use for determining it can be considered altogether satisfactory. Writing in a contemporary on this subject, Mr. Cuthbert Hall describes a method of testing small transformers by measuring the watts delivered to a direct current motor, which is used to drive the alternating current machine supplying the transformer, and claims for it that it is a method to which few theoretical objections can be made.

To us it appears to be open to the very grave objection that the quantity to be determined, namely, the watts given to the transformer, will generally be but a small fraction of the quantity actually measured, viz., the watts delivered to the motor, and that the difference between these two will be largely represented by frictional losses, which are liable to considerable variation. Of course this objection becomes less important when the motor and alternator are so proportioned to their work, that both are running at their most efficient loads ; but unless different machines are used for the full load and light load tests, this condition cannot be fulfilled.

In the actual tests quoted by Mr. Hall, a low pressure alternator was used with two 750-watt transformers, one to transform up, and the other down ; and the efficiency of the latter was calculated by dividing the losses equally between the two. This is done in a somewhat novel manner ; the efficiency of the two transformers is first calculated, and at full load, for instance, is found to be 82·8 per cent. ; then, says Mr. Hall, 17·2 per cent. is lost in the two transformers, or 8·6 per cent. in one, which gives 91·4 per cent. efficiency. The error is not very much, as a percentage at full load, but when the same method is followed out for the light-load tests, it becomes serious. For example, taking the case of quarter load, the figures given are 1,997·5 watts supplied to the motor, 206 watts delivered by the transformer under test, and a combined efficiency of motor and alternator of 30·33 per cent. The watts supplied to the step-up transformer are therefore 606, giving 34 per cent. as the efficiency of the two transformers. Mr. Hall says, the loss in the two transformers being 66 per cent., the loss in one is 33 per cent., and therefore the efficiency of the transformer is 67 per cent.; but, if the losses were equal, the efficiency of the step-up transformer would indeed be $\frac{406}{606} = 67$ per cent., but that of the transformer under test would only be $\frac{206}{406} =$ 50·7 per cent.

The assumption that the losses are equal is, however, quite unwarranted, and indeed is disproved by the figures given by Mr. Hall. If we suppose, for the sake of argument, that they are equal when the test transformer is $\frac{3}{4}$ loaded, we find that 666 watts are supplied to the step-down transformer when it delivers 562 watts; *i.e.*, its efficiency is 84·4 per cent. When the output of this transformer is 397 watts, the step-up transformer is receiving 675 watts, and should therefore have an efficiency at least equal to 84·4 per cent., in which case it would supply 570 watts to the second transformer. The losses would then be 105 watts in the step-up, and 173 watts in the step-down transformer, and the efficiency of the latter at half-load would be $\frac{397}{570} = 69{\cdot}7$ per cent., and not 79·35 per cent., as stated.

The tests show a very considerable increase in the loss as the load is diminished; in fact, the loss on open circuit is given as nearly four times the loss at full load; and we can only hope, for the sake of any supply company who may be using these tranformers, that these tests do not give a correct result as regards internal losses; as with an efficiency of 70 per cent. at half load, and a loss of something like 300 watts on open circuit, the all-day efficiency that Mr. Swinburne has so often referred to will not be an encouraging figure for that company to contemplate.

CAPITAL PUNISHMENT BY ELECTRICITY.

THE *Lancet* appears to be very antagonistic to the execution of criminals by means of electricity. Taking as its text in this week's issue, the detailed report which two of the physicians who had charge of the electrocutions at the Sing-Sing prison, New York, in July last, have just issued, it indulges in some rather severe comments, which we think are not entirely justified. These proceedings were "experimental" it is true, but we cannot agree with the *Lancet*, which endorses the opinion of the *Medical Record*, New York, when it says they were not very satisfactory even in the form of experiment. What, we should like to enquire, would the *Lancet* have to say regarding some new surgical operation upon a patient, involving life and death, if the operation turned out to be half as successful as the New York electrocutions did? We venture to think it would have exhibited quite as much enthusiasm as that shown by those who have been endeavouring to discover a more humane method of capital punishment than is hanging.

The *Lancet* inveighs against the presence of doctors at the electrocution, and, we presume, at the careful reports which they have issued. It says: "The best minds will stand astounded at the fact that any medical man or men could be found ready to dip their hands into any part of such fearful work. If anything of service to humanity were gained by it, if any suffering, sorrow, or death were saved by it, if anyone were made the least bit nobler or more useful by it, there might be some excuse. But to take the loathsome job out of the hands of the common executioner is beyond comprehension. The office of the public executioner is that of a person who for gain kills another man lawfully; whether by the cord, the knife, the bullet, or the electric shock, is simply a matter of detail." All this, we beg to say, is unworthy of the leading medical journal in the country. It is an attitude quite inconsistent with that which becomes a great organ of medical and surgical science and such observations as we have quoted resemble more the hysterical ravings of an antivivisectionist.

Let us remind the *Lancet* that the prison surgeon is always present in England at executions by hanging. Is this official therefore to be charged in such uncompromising terms with "imbruing" his hands" in "fearful work," &c. And are there not plenty of cases on record where, the prison surgeon being present, more horrible scenes than those witnessed in the Sing-Sing prison (which we decline to admit *were* horrible), have been enacted?

Finally, what a howl there would undoubtedly have been raised if the electrocutions had been performed without a single medical man being present.

THE PROPOSED UNDERGROUND ELECTRIC RAILWAY IN PARIS.

ACCORDING to the vote of the Paris Municipality, the Administration has opened an enquiry into the scheme for the construction of underground electric railways in that city. This project, which it will be remembered, is due to M. Berlier, provides for a line between the Bois de Boulogne and the Bois de Vincennes, the railway passing under the Avenues d'Eylau, Victor Hugo and Champs Elysées, Place de la Concorde, Rues de Rivoli and Saint Antoine, Place de la Bastille, Rue de Lyon, Boulevard Diderot, Avenue Daumesnil, Rue Rambouillet, Rue Erard, Boulevard Diderot, Place de la Nation, and the Cours de Vincennes.

It will be evident that the projected railway would pass from east to west of the city. It would be 6·82 miles in length, and would comprise a single tunnel made of iron instead of masonry. The joints of the plates would be made watertight, and prevent any percolation of water into the tunnel. Efficient ventilation would be provided by the construction of a number of shafts along the route of the line, and the tunnel itself would be lighted by electricity. The carriages would also be illuminated by electricity, the platforms being level with the floors of the coaches, in order to reduce to a minimum the time of stoppage at each station. It is proposed to adopt a speed of from 22 to 25 miles per hour, and a fare the same as by omnibus, namely, 30 centimes (3d.) for first, and 15 centimes (1½d.) for second class. It is believed that the result of the enquiry will be favourable to the construction of the line, which would be built without breaking open the public thoroughfares.

The Electro-magnet in Surgery.

IT has often been our duty to enter a caution against the quackery that deceives the unwary with its so-called magnetic and electric "appliances." Between, however, the medical electricity of the advertising charlatan and electricity as occasionally employed in a legitimate way by the qualified practitioner, there exists a vast difference, which our readers will not be slow to perceive, and which by its strong contrast places the practices of the former in a by no means favourable light. As an instance of electricity used as an adjunct to surgery, we may notice a case recorded in the *Lancet* for October 24th. A man was engaged at the Pontypridd colliery stamping some new tools by means of a steel stamp and hammer, when a fragment of steel flew off and struck him on the left eye. He at once went to the foreman and asked him to see if the piece of steel was in the eye. The foreman "wiped a drop of blood from the white of the eye, but could see nothing there." In a few days distressing symptoms began to set in, which ultimately became so intense that the man was sent to the Cardiff Infirmary, where he was treated by Dr. J. Tatham Thompson in the following way. The original wound was reopened by means of a cataract knife, and the curved pole of an electro-magnet introduced. At the second attempt the fragment of steel was drawn through the opening "in tow" of the magnet. The wound, of course, was afterwards properly treated with antiseptics, &c., and in a few weeks the man was able to resume work with but slightly impaired sight. So far as can be ascertained, the only cases previously recorded of successful removal of foreign substances from the retina (for that was the particular part where the steel lodged) are those of Galezowski and Hirschberg, and this operation marks an epoch in the surgery of the eye. The electro-magnet used by Dr. Thompson was a modification of Snell's, made to the doctor's designs by Messrs. King, Mendham & Co., of Bristol; and the battery employed consisted of two bichromate of potash cells of one quart and one pint capacity. We believe, however, that there are many unpublished instances of small pieces of steel which had entered the eyes of millers engaged in dressing millstones, being extracted by the aid of permanent magnets.

Science Smatterings.

"ALL the scientific food we purvey will be the best of its kind, and our first number which we now have the pleasure of presenting to the public is a fair sample of the way in which it will be served . . . . . We now invite our readers to analyse our first offering." This is the strain in which a new "scientific newspaper," to wit, *Science Siftings* introduces itself to the public. While declining the ingenuous invitation to "analyse" the "first offering," we really must enter a protest against the inaccurate and misleading way in which the science of electricity is dealt with. One of the longest articles, and we presume the most important from the editorial point of view, is entitled, "What is electricity?" Although, as might be expected, the question is not answered, we are told that there are three kinds: "First is the lightning which nature produces; then there is battery or static electricity, which is generated by dissolving chemicals in cells or batteries; the third sort is dynamic, being generated by a dynamo"!!! In another part of this paper it is written "we shall cater for the tyro as well as the advanced student." If the editor is a wise man he will attempt to "cater" for neither. We know with what disgust the "advanced student" will regard such "pabulum;" as for the tyro, if he doesn't arise from the feast with a bad bilious attack, we shall be surprised. The description of the way in which "volumes of electricity" are generated by the dynamos, and the exposition of arc and incandescent lighting, are delicious examples of "science popularly explained" by (let us seriously hope) a newspaper man. We *must* quote the explanation of induction, "When a wire charged with a heavy current of electricity is strung parallel for a considerable distance to another wire upon which there is no electric current, or a much weaker current, the strongly charged wire excites in the weaker wire a sympathetic current which moves in the opposite direction, but vibrates, pulsates, crepitates, and in all other respects reproduces the manifestations of the current in the stronger wire. This is induction"!! *Ex uno disce omnes.* Finally, in another part of the same article we read: "This is, in short, the story of the generation and application of electricity for power and light. Some people who read it will wonder why it is printed. (Yes! *we* do.) Others who went to school before this electrical age began, and who have read darkly of the use of electricity, will read this brief explanation and feel that some of the mystery of the new industrial energy is cleared up for them." Others again, let us add, will feebly sigh for some power which shall keep pens, ink and paper from the hands of this "scientist," who thus clears up "mysteries," for the rest of his natural life. If the first number of *Science Siftings* is, as its editor asserts, a fair example of those which are to follow, then let the title be changed to "Science Smatterings"—a much more accurate heading, or let the editor do his "sifting" in a more intelligent manner.

Temperature Coefficients.

IN the correspondence columns of a contemporary, Mr. J. Leslie Fuller suggests that for convenience in correcting the insulation resistance of G.P. core for temperature, all tests should be reduced to 60° Fahr., instead of 75° Fahr., as at present. There is no doubt that the average temperature of submarine cables when laid is nearer 60° than 75°, but on the other hand the test of the unsheathed core at the higher temperature is the more severe of the two, and it is always advisable to test under the most trying conditions; and at whatever temperature the core is tested, to that temperature shall the correction be made. 60° Fahr. has been adopted as the standard temperature for electric light cables, but it would be better to raise the temperature for these latter, as when a current is flowing it can but seldom happen that their working temperature is below 75° Fahr. Merely as a matter of convenience the higher temperature has a great advantage, as it often happens that the natural temperature of the water in the tanks is above 60° Fahr., and it is much easier to raise the temperature artificially than to lower it.

Novel Electric Lighting Scheme for Edinburgh.

PROF. FORBES has just suggested a novel scheme for running proposed rubbish destructors and the electric lighting of Edinburgh by water power. Taking the electric lighting of Geneva as his example, Prof. Forbes has pitched upon Arthur's Seat in the Queen's Park, Edinburgh, as a hill extremely convenient for his purpose. On the slope facing Portobello he would construct a reservoir about one hundred yards square. In some outlying part of the city a destructor could be erected. The surplus steam from the destructor could work a steam engine, which would pump water into the reservoir. The reservoir by another pipe would supply power to turbines, which would transmit their power to dynamos for supplying the city with electricity. Under the ordinary scheme, Prof. Forbes points out, it is required to keep up a full supply of electricity during the day, while with the reservoir plan of working the power could be turned on when required, thus saving an enormous amount of unnecessary expense. Prof. Forbes may have reason to be proud of this roundabout way of utilising waste steam, but most people would be contented to use it direct or with storage batteries.

VERIFICATION OF THE LAW OF THE DEVIATION OF EQUIPOTENTIAL SURFACES AND THE MEASUREMENT OF THE DIELECTRIC CURRENT.*

By A. PEROT.

ACCORDING to the law of the deviation of equipotential surfaces (refraction), if K_1 and K_2 are the dielectric constants of two media, then the angles α and β, which an equipotential surface makes with the surface of separation of these two media and on each side of it, have the following relationship:

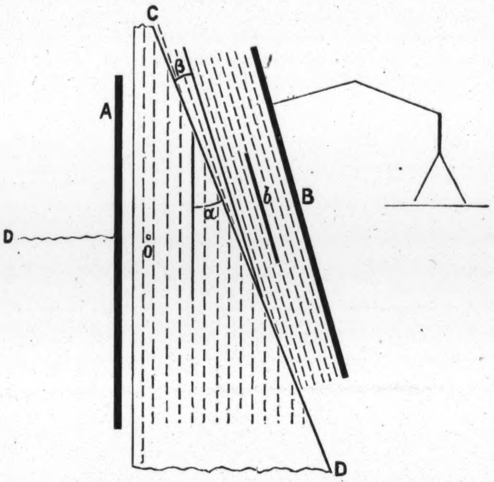
$$\frac{\tan \alpha}{\tan \beta} = \frac{K_1}{K_2}$$

when the second medium is air, this relation may be written

$$\tan \alpha = K \tan \beta. \qquad (1)$$

where K is the dielectric constant of the first medium.

Suppose a dielectric solid-shaped, in the form of a prism of very large dimensions, and let a large metallic plate, A (*vide* fig.), charged at a constant potential, be placed very near, and parallel to, one of the faces of this prism. We may imagine that the field presents the following form: in the dielectric, equipotential surfaces plane and parallel to the plate, A; in the air, equipotential surfaces also plane and parallel, but with regard to the plate, B, which is conveniently placed. In this case the angles, α and β, made by the two plates, A and B, with the face, C, D, of the prism are given by relation (1), this form of the field only existing some distance from the edges of the plates, A and B.



If B is brought to zero potential, and then connected with a gold-leaf electroscope that is moderately sensitive, no movement of the leaves ought to be seen, when a small, very thin and insulated metallic plate, *b*, is placed parallel to B, and therefore to the equipotential surfaces, the field being then but very slightly disturbed.

If the field is not uniform and parallel to B in the air, every displacement of *b* will modify the capacity of the condenser formed by A and B, and will be accompanied by a disturbance in the leaves of the electroscope.

Whatever the position of B may be, the equipotential surfaces in the immediate neighbourhood of it will tend to be parallel to this plate; but the surface in the neighbourhood of C D, influenced by A, will not in general be parallel to B, so that when owing to the presence of *b* they are induced to become parallel to B, the field will be deformed. The only case in which the influence of the displacement of *b* may be *nil*, is that in which the equipotential surfaces are parallel to B as far as the dielectric; and this case is realised in the field previously described. [In reality there is always a deformation of the field at the edges of the plate, *b*; but if this plate is very fine and of large dimensions, the deformation is very small.]

To each of the forms of field realising this condition should correspond a position of B, unless we may say *à priori* there exists several of these forms. It can be shown that the form of field represented in the fig. ought to exist, and hence if experiment reveals that there is only one form, this will necessarily be the one; and experiment will decide whether this is the fact or not, if the orientation of B is independent of its distance from the edge of the prism.

It is necessary then to operate in the following way:—The plate, *b*, being constantly parallel to B, put B in such a position that the displacement of *b* does not influence the electroscope, and then see if this condition is realised in one or more positions of B.

Now *b*, being supported by silk fibres suspended from a frame which is movable parallel to B, and the whole arrangement of B and *b* being movable around a point, O (*vide* fig.). We place B in a certain position; we bring it to zero potential, then we displace *b*, taking note of the behaviour of the electroscope.

It is generally impossible to maintain the potential of the plate, A, exactly constant, and, on the other hand, the gold leaves in repose; but their very slow movement due to this cause cannot be confused with the rapid rythmical movement which the displacement of *b* produces owing to the variation in the capacity of the condenser formed by A and B.

When these operations are repeated for a series of positions of B, we at last arrive at a position for which the displacement of *b* does not influence the electroscope.

This position is *unique*, and the angle of the plates, A and B, which correspond to it, is independent of the distance of the medium of B from the edge of the prism.

By measuring this angle and that of the prism, we may calculate the angles, α and β.

The experiments were made with a rectangular prism of resin containing $\frac{1}{10}$th of wax, and of which the sides of the base were 40 cm., 20 cm., and 44·7 cm.; the height 30 cm. For K values were obtained varying from 2·02 to 2·05, the distance of the centre of B from the edge varying from 15 cm. to 25 cm., and the mean distance of B from A varying 15 to 20 cm.

The constancy of the results fully justifies this conception of the field uniform in air and in the dielectric, and, consequently, the method.

A prism of the same resin, of which the sides were 30 cm., 30 cm., and 42·4 cm., has given values varying from 2·00 to 2·10, and agreeing, therefore, with the preceding values, and hence the law of refraction may be considered to be verified.

The index of these prisms for the ray, D, was 1·477, and the square of this is 2·18, which is very closely approximate to the value of the dielectric constant.

The numbers found were independent of the time of charge; the production of and presence of the residue had no influence whatever. [This result tends to prove that the residue is due to electrolytic polarisation in the conducting "cellules" spread out in the dielectric and having no influence on the equipotential surfaces.]

A prism of smaller dimensions gave for the value of the constant 3·5 under circumstances, however, of less precision on account of the influence of the edges.

These experiments were made with a potential of between 25,000 and 40,000 volts.

TOMMASI'S ELECTRIC MULTITUBULAR ACCUMULATOR.

AT a meeting of the Paris Academy of Science, held on October 12th, D. Tommasi, whose name is well known in connection with accumulators, presented one of those which he has recently invented, and which possesses several novel features.

Each electrode is composed of a perforated tube made of lead, ebonite, porcelain, or celluloid, the bottom of which is closed by a plate of ebonite, in the centre of which is fixed a lead rod, which acts as a conductor.

The space between the central rod and the sides of the tube is filled up with oxide of lead. Metallic contacts respectively connect up all the rods of the positive electrodes, and those of the negative electrodes.

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* *Comptes Rendus*, cxiii., p. 415, September 28th.

The tubular electrode is either cylindrical, square, or rectangular, and the shape of the central rod is varied accordingly.

The principal advantages of this accumulator are as follows :—

1. The current passes entirely through the active materials, from the surface of the tube to the central rod, or *vice versâ*.

2. The quantity of material that is active is a maximum, and then the weight of the accumulator is from two to six times less, and its volume from four to eight times less than in other accumulators of the same strength.

3. A current of more than 60 ampères per kilogramme of electrode can be sustained, whereas in the ordinary types 1 ampère per kilogramme is generally employed.

4. Breakages, which are so frequent in plate accumulators on account of unavoidable weakness in structure, &c., are not to be feared.

5. In this accumulator it is quite impossible to have any dilatation of the tube electrode, therefore no escape of matter, therefore no short-circuiting.

Rectangular lead accumulators are the best for station work, and the celluloid form for tramway purposes.

Here are some figures which refer to a rectangular multitubular lead accumulator containing 67 per cent. of active matter :—

Electromotive force	2·4	volts.
Capacity per kilo. of electrode ...	16	ampère-hours.
Output in quantity	95	per cent.
Output in work	80	„

REFORM IN RAILWAY CONSTRUCTION.

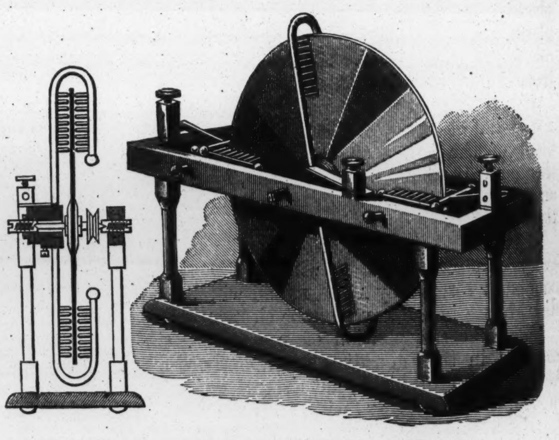
WE have received, in pamphlet form, a copy of an article entitled as above, and which is a reprint from *The Forum*, an American contemporary. The article is from the pen of Mr. Oberlin Smith, who wields it with no sparing hand. We will hope that American railways are not all that Mr. Smith so trenchantly declares :—Instability of road, track obstructions, weakness, lack of continuity in rails, curves of short radius, narrowness of gauge, top-heavy cars, general liability to derailment, insufficiency of brake power, physical discomfort to passengers, special danger to employés, such is but a portion of the indictment brought by the author against the railway systems of the United States, and, for that matter, as we gather from the opening part of the article, his remarks apply generally to colonial railways the world over. "32,132 people were killed and wounded by the railways of the United States during the year ending June 30th, 1889. Of these 22,000 were employés, of whom 1,972 were killed and 20,028 were wounded. Of passengers and other non-employés, 3,851 were killed and 6,281 were wounded." Truly a heavy bill! We are not told the total train mileage run, or we might attempt a comparison with our own railway casualty list for the same period. Much of this loss of and injury to life, Mr. Smith is of opinion, will be suppressed when electricity becomes the motive power by which railway traffic is conducted. We fervently hope it may be so, but seeing that when this change of motive power does take place, it must still leave the work to be dealt with in the same category as at present, we hardly follow him. It may be that with electricity we shall have a more complete controlling power in the direction of insuring a definite space between train and train, and thus mishaps from collisions will not be possible, or greatly reduced ; but a careful study of the causes of casualties to life and limb on railways will show that the great sacrifice does not arise from collisions, but from many minor causes resulting in individual cases all telling up at the year's end a large and deplorable total. The major portion of these causes will attach to electrical as well as steam locomotion.

Sweeping as are Mr. Smith's denunciations of the railways of his country, he will carry with him his readers in his observations of the reason for such a state of things, or, as we would rather say, of so much as appertains to it. He admits freely that they have been, so far, "fairly well adapted to their environments;" that one of the chief factors "has been poverty;" and that railways could not have existed at all had they "demanded enough construction money to make them as perfect as might have been desired by the best engineering talent." Undoubtedly, had those who pioneered these lines built them and equipped them as are English lines, they would not have been built for very many years : civilisation would not have advanced with that rapidity which has characterised it ; and the resources of the country must have lain dormant for, possibly, centuries. Railways have been to America, as to our Colonies, and will be to all newly opened up countries, the roadways of the land. Railways will follow telegraphs, or the two will walk hand in hand. Without them, civilization and commerce will stand stagnant, or be conducted at great cost and great labour. All this is practically a truism, and goes without the saying. But what is to be done to remedy the defects so abundant to the mind of Mr. Oberlin Smith ? This is the question which all will ask themselves. Electrical railways ! In their adoption lies the antidote. We doubt not that when electrical railways, of such a character as to supersede the present means of railway locomotion, are adopted, advantage will be taken of the experience of the past, both in the construction of the permanent way and that of the rolling stock, so as to avoid, at all events, the greater portion of those evils which have called forth the denouncement bestowed upon them by the author. When those days come, posterity will, no doubt, recognise Mr. Smith's labours in their interest. We fear, however, we must not hope to witness so great a revolution in the near future. Electric railways will come, but like all other enterprises of such a character, they will come slowly. That they will entirely supersede the steam locomotive is at the least, viewed with our present knowledge, problematical. When established it will probably be for passenger traffic only, and that between the chief and most populous centres. Railways, as at present constructed, and as at present conducted, must for years to come carry the main traffic.

Accurate as may be Mr. Smith's views, we fear his anticipations are far in advance of the possibilities of the day. With electrical locomotion we may expect many improvements, but it is too much to look upon it as the *panacea* of all the ills which attach to our present railway system.

A SIMPLE FORM OF ELECTRIC MOTOR.*

A MOTOR adapted for the use of students and for experimental purposes especially intended to be operated by static charges, and which may be used with a different number of combs, or have the electricity thrown upon one side of the main disc only, is shown in perspective and vertical cross section in the accompanying illustration. It has been patented by Messrs. John W. Davis and John B. Farrington, of No. 32, East Forty-fifth Street, New York City. A dielectric disc is mounted to revolve centrally in the frame, the shaft on which it is secured having tapering ends pivoted to the inner socketed ends of screws, the screws being held in nuts sunk into the frame, and the bearings being insulated so that the electricity on the disc cannot be grounded. The disc shaft has a pulley



DAVIS AND FARRINGTON'S ELECTRIC MOTOR.

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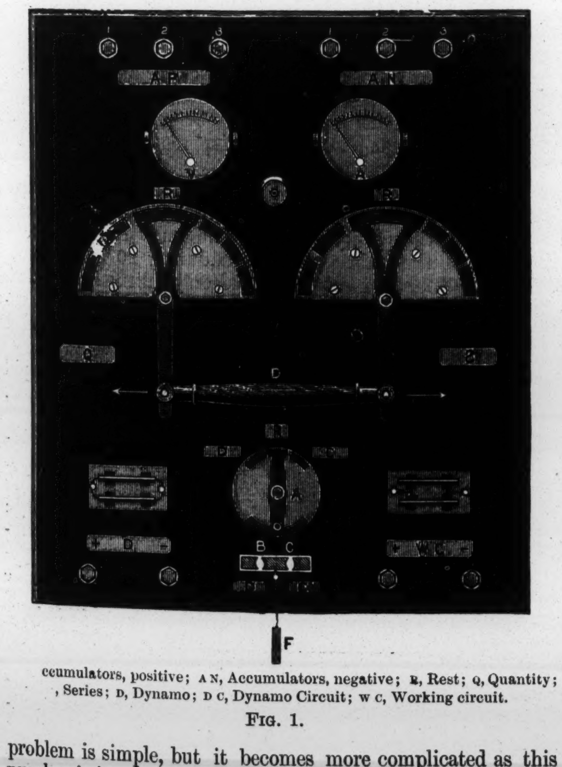
* *Scientific American.*

on which a belt may be placed to run any light mechanism. At one side of the frame is a strip carrying a sleeve encircling one end of the shaft, both strip and sleeve being of rubber or other insulating material, and on the sleeve is mounted a hub having arms extending from opposite sides and bent over the edges of the disc, the arms carrying metallic teeth forming combs, the ends of the teeth nearly touching the disc and serving to conduct the electricity to it. The hub is held in fixed position by a set screw, and has gauge marks, by which the arms may be brought into a desired position. Electricity is supplied to the combs, the arms, and the hub by a contact strip resting on the hub and secured to a suitably connected binding post. Arranged on opposite edges of the disc, early at right angles to the combs on the arms, are other combs made in two parts, each part having an insulated shank mounted in the frame, these combs receiving the discharges from the disc, and their shanks being connected by a conducting bar on the side of the machine opposite that shown. The combs on the arms and those held by the frame are arranged in slightly different planes, to prevent the electricity in one comb neutralising that in the opposite comb, and thus holding the disc at a standstill. Contact is made with the horizontal combs by T-shaped conductors, the ends of the shanks of which are bent at right angles and pivoted in binding posts, so they may be readily swung out of contact with the combs. With the binding posts on the ends of the frame connected with the positive pole of a source of electric supply, and the post near the hub connected with the negative pole, the electricity will pass from the horizontal combs upon the disc, which will then be repelled and attracted by the combs on the arms, thus causing the rotation of the shaft, the current keeping it in motion. The arrangement and connection of the combs is such that a greater or less number of them may be thrown into a circuit, according to the experiment to be made. The electricity is preferably supplied by an electric machine, Leyden jar, or some similar source.

DISTRIBUTION BOARD.

The object of this board is to effect quickly and readily the grouping in series or quantity of several batteries of accumulators. When two batteries only are needed, the problem is simple, but it becomes more complicated as this number is increased.



ccumulators, positive; A N, Accumulators, negative; R, Rest; Q, Quantity; , Series; D, Dynamo; D C, Dynamo Circuit; W C, Working circuit.

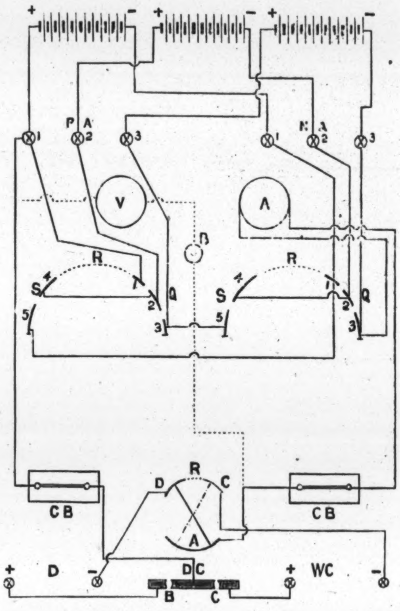
Fig. 1.

Let us suppose (writes M. Aliamet in *L'Electricien*) that we have to charge accumulators which are required to furnish a considerable output and which are placed at some distance from the charging dynamo; it is evident that if we do not wish to employ a long extent of line, it will be to our advantage to divide the accumulators into several batteries charged in series and discharged in quantity.

The reverse of the problem may also be studied, so that the charge may be effected in both ways and also the discharge.

Fig. 1 shows the arrangement of the distributing board; fig. 2, the connection between the various parts.

It will be observed that the circuit breakers placed on the positive and negative conductors, serve both for charging and discharging; this also applies to the voltmeter and the ampèremeter.



P A, Positive accumulators; N A, Negative accumulators; V, Voltmeter; A, Ampèremeter; B, Button; R, Rest; S, Series; Q, Quantity; C B, Circuit breaker; D, Dynamo; D C, Dynamo circuit; W C, Working circuit.

Fig. 2.

The commutators connected by the insulating coupling bar, D, are alikė; the sector displaced on each is of sufficient range to cover simultaneously either the three left or the three right blocks.

We will suppose that we have to charge the three batteries in series; the commutators are at rest and the plug, F, hanging loose.

The three following operations must then be performed in the order stated:

1. The coupling bar, D, must be pulled to the right (in the direction of the arrow placed under the label) series.
2. The plug, F, must be inserted in the hole, B.
3. The handle of the commutator, A, must be placed over "dynamo."

The charge is stopped:

1. By placing A at rest;
2. Taking out the plug, F;
3. Bringing the sectors to the position of rest by means of the coupling bar, D.

To discharge the three batteries in quantity:

1. The bar, D, must be drawn to the left (in the direction of the arrow placed under the label "quantity").
2. The plug, F, is inserted in the hole, C.
3. The handle of the commutator is put at "circuit."

If we wished to charge in quantity and discharge in series, we should merely have to change the first operation in the directions given.

For charging we should draw D to the left, putting A over "dynamo" and F into B.

For discharging we should draw D to the right, putting A over "circuit" and F into C.

By using one plug only we avoid mistakes.

C

As the current is not alike during the charge and the discharge, and as, consequently, the circuit breakers would not answer in both cases, interrupters with two movable bars are used; one bar is of thin lead, affording sufficient protection when the current is least (as when the connection is in series). When the current is greatest (as when the connection is in quantity), the second bar, which is thicker, is added; thus, the two fusible bars being connected in quantity on the same interrupter, they are calculated to afford the protection required.

RECENT ELECTRICAL RESEARCHES BY RUSSIAN PHYSICISTS.

THE study of the science of electricity is evidently making considerable progress in Russia if we may judge from the *Journal de la Société Physico-chimique Russe*, vol. xxii., just received.

It appears that during this last session the section devoted to physics has held nine meetings and received no less than forty-three communications. The last two meetings were devoted to experimental demonstrations amongst which was a repetition of the experiments of Hertz, performed under the direction of Mons. Egoroff.

One meeting was signalised by an exhibition of all the apparatus more or less original which have been the subjects of communications at the various meetings of the *Société Physico-chimique Russe* during the past ten years. And on another occasion there was an exhibition of an historical character in which the evolution of the galvanometer was traced, some of the original instruments used in the classical experiments of Lentz, Jacobi, Newlander, and others being on show.

Amongst the communications made during the past session more especially relating to electricity, we may notice the following:—On page 97, there is a description of an apparatus by A. Colley, for observing slow electric oscillations.

P. Goloubitsky has given long and detailed accounts of his new telephone system.

Actino-electric experiments have been the subject of a communication by A. Stoletoff, who described and illustrated by experiment some of his latest researches. We notice that some of his observations appear to contradict the statements of Estler and Geitel; thus he shows that the surface of amalgamated zinc *is* influenced by rays of light which have passed through glass and that very pure hydrogen gas does not exhibit any anomalous behaviour as has been stated.

A. Cheinkoff (pp. 102—106) has carried on some researches with the object of eliciting whether the electromotive force producing electrical separation is distinct from the causes which set up electric currents.

At page 106—109, C. Swietowidoff establishes the fundamental equation of a theory of electricity and magnetism, based upon the conception of an incompressible fluid ether and Sir. W. Thomson's "vortex" notion. This theory involves the supposition that magnetic energy is the energy of a progressive movement of the ether, whilst electric energy is that of an angular movement of the ether.

R. Colley makes an important contribution to the theory of the Rhumkorff coil on pages 98—102. He states that the differential equations representing the movement of electricity in the coils of an induction apparatus are simplified if it be supposed that the reaction of the secondary circuit upon the primary circuit is *nil*. The integration becomes simple and the intensity of the current, J, is expressed by the sum of two exponential functions of time, of which one is periodic and the other is not.

$$\mathrm{J} = a\left(-e^{\frac{-\mathrm{R}t}{\mathrm{L}}} + e^{-a\tau}\,\mathrm{C}\,s\,\beta\,t\right)$$

Where R = the resistance of the secondary circuit.
" L = its coefficient of self-induction.
" τ = the period of oscillation of the contact breaker.
" $\beta = 2\,\pi\,\tau$.
" $a = \frac{r}{2}\,l$.
" r = the resistance.
" l = the coefficient of self-induction of the primary circuit.
" a, s, C, are constants.

The calculation received confirmation by means of experiments with a Geissler tube, a revolving mirror, and a Rhumkorff coil. E. Spatschinsky describes his symmetrical systems of magnets, and their application to various physical apparatus. He has succeeded in adapting such systems to the construction of

1. A galvanometer with deflections proportional to the intensity of the current.
2. A transformer.
3. A dynamo-electric machine without collector.

On pages 135—137 are described some experiments with the "dynamo disc" invented by A. Polechko.

This is founded upon the principle of Faraday's disc. A thick disc of copper is pierced in the direction of its radii and thus divided into 320 sections, the hollow parts being filled in with vulcanised fibre. The middle part of the periphery of the disc is covered with a ring of steel insulated from the copper by means of vulcanised fibre and thus binds the whole together. Two pairs of collectors slide upon the free surface of the periphery of the disc, touching it at the extremities of its horizontal diameter.

The magnetic field is furnished by two electro-magnets, horseshoe-shaped, placed vertically and furnished with an arrangement for concentrating the field along the horizontal diameter of the disc. This apparatus appears to give very good results.

There are papers on the mechanical action of alternating currents by J. Borgman, which we have noticed elsewhere.

In a paper entitled "A Contribution to the History of the Galvanometer," Th. Petrouschewsky expresses his opinion that the most ancient galvanometer of precision is that invented by Nervander, and described by him in the *Annales de Chimie et de Physique* in 1833.

On pages 117, 118 are described a number of experiments made by W. Tschegliaeff on the action of a magnetic field upon discharges through Geissler tubes, and an attempt is made to explain the appearance of the stratifications of the light in the tube when under the influence of electric or magnetic fields.

S. Kowalewsky describes a large number of more or less complicated phenomena of the same kind as those of the rings of Nobili, of the equipotential figures of Guébhard, and of the electro-capillary movements which for several years past he has been studying in electrolytes.

A new form of dip-needle is described by N. Pittschikoff.

On pages 132—135. G. Imchenetzky gives an account of his new galvanic element. This element is formed by mixing graphite with paraffin and fixing it by compression upon both surfaces of a piece of metallic cloth in a solution of chromic acid and of zinc in a solution of hyposulphite of soda. The solutions are separated by means of a porous diaphragm. In the mass of the diaphragm there forms an impermeable but conducting film.

The electromotive force of the element is equal to 2·15 volts. The resistance varies between 0·04 and 0·07 ohm, according to the quality of the diaphragm. In one experiment this cell furnished 150 watts during 20 hours' work, and then its electromotive force had only fallen to 2·0 volts.

During the working of the cell the hyposulphite is transformed into sulphate with a precipitation of sulphur, whilst the chromic acid becomes oxide of chromium.

The employment of the bolometer for observing rapid electric oscillations and for determining dielectric constants, is discussed by W. Tschegliaeff on pp. 115—117.

Altogether, this issue of the *Journal de la Société Physico-chimique Russe* shows that Russian *savants* are determined not to be behind those of the western nations in pushing forward researches into the hidden mysteries of electricity; and since abstract research is really so closely related to invention, we may safely predict that the knowledge and applications of electricity are destined to rapidly develop in the land of the White Czar.

Electric Light in the Southern States of America.—During the past nine months, great activity has been displayed in the establishment of new enterprises in the Southern States of America. Among the new ventures, which number 2,472, there are 20 gas works and 124 plants for furnishing electric light.

POLYPHASED ALTERNATE CURRENTS.

(Continued from page 476.)

III.—TRANSFORMATION.

Transformation.—As polyphased alternate current generators are constructed to produce currents of great intensity and low electromotive force, while the application of these currents, in the present state of electrical industry, are directed mainly to the transport of electrical energy to a great distance, it follows that these currents must be transformed twice between the point of production and the point of utilisation, the first time to increase their tension at the expense of their intensity, and the second time to reduce this tension and render the currents harmless and capable of being manipulated. This is the work of the transformers.

The polyphased alternate current transformers do not differ essentially from ordinary alternate current transformers, and consist of closed magnetic circuits enclosed in two windings, one of thick wire and one of fine. In the apparatus supplied by the Allgemeine Electricitäts Gesellschaft and the Ateliers d'Oerlikon we find essentially the same principles, the apparatus only differing in details of construction.

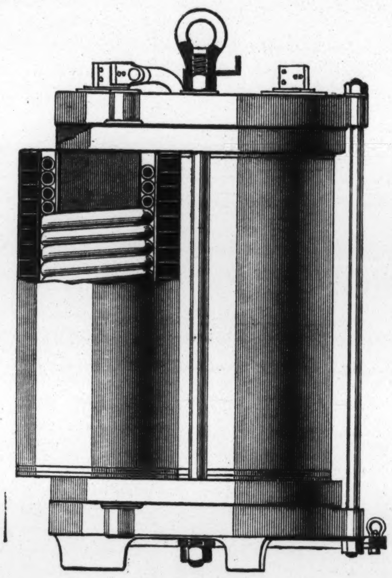
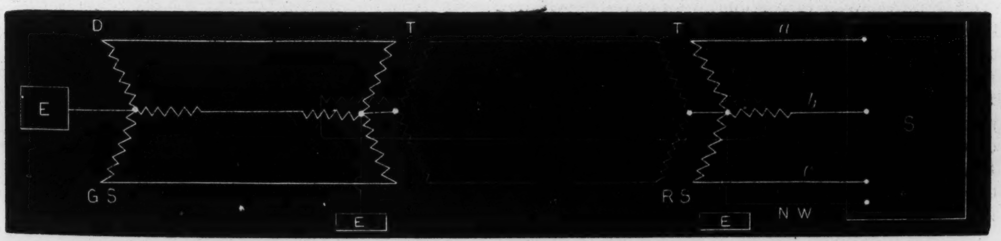


FIG. 1.

Three cylindrical iron cores (fig. 1), formed of layers of thin soft sheet iron that has been well annealed, rest on an annular disc of sheet iron, and are covered with a second disc of sheet iron of the same thickness, the two discs being formed of one sheet of iron, rolled like a ribbon on a bobbin. The three cylinders are each enclosed in two windings of copper wire.



E, Earth; T, Transformers; D, Dynamo; S, Switchboard; G S, Generating Station; R S, Receiving Station; N W, Neutral wire.

FIG. 2.

In the transformers placed at the generating station, the thick wires are connected with the dynamo, and the fine wires with the line of transport, as shown in fig. 2.

At the other extremity of the line (the arrival station) the fine wires of the transformer are in communication with the line of transport at a high potential, and the thick wires are connected with a distribution board, from which the conductors supplying the different utilisation apparatus radiate. We can see that at the points of departure and arrival it is possible to connect the inductive and induced circuits either in a triangle or a star, as required. In the Lauffen-Frankfort experiments, for reasons which will become evident when the utilising apparatus is examined, the "star" connection has been preferred. The transformers at Lauffen and those at Frankfort have a coefficient of transformation equal to 160, that is to say, a difference of potential of 50 volts established at the terminals of one of the inductive bobbins produces a difference of potential of 8,000 effective volts at the corresponding terminals of the induced circuit. This difference of potential is that which exists between the neutral point and each of the wires. If we trace the curves representing the differences of potential between each of the wires and the neutral point, and call e the difference of potential between the neutral point, o, and the outer extremity of the bobbin, a, we can easily see that the effective difference of potential, E, between any two wires is greater. The relation between E and e is

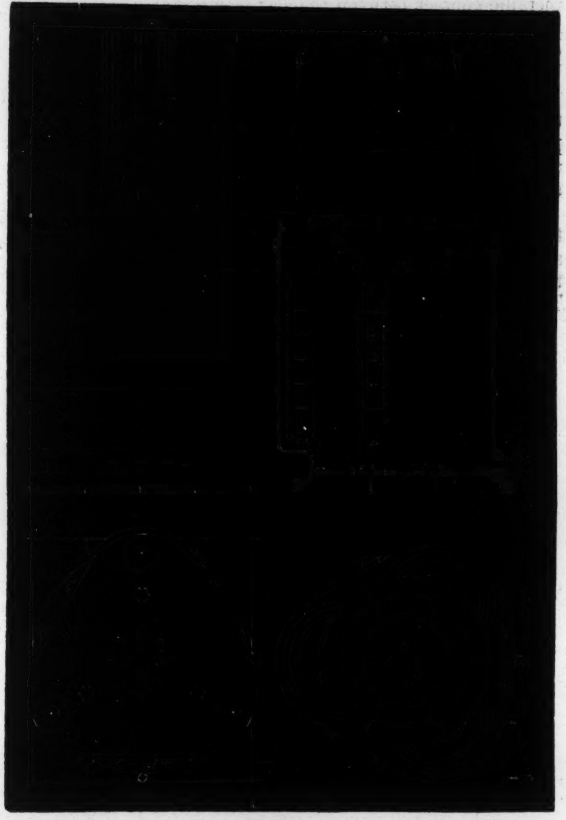


FIG. 3

$$E = e\,2 \sin 60^\circ = 1{\cdot}732\,e.$$

A difference of potential, e, of 8,000 volts between the neutral point and each of the wires corresponds, therefore, to a difference of potential, E, of 13,850 volts between any two wires.

It is in consequence of the high tensions which are now used, and which will be exceeded eventually in subsequent experiments, that special precautions have been taken in the construction both of the transformers and the line. As these precautions have been sufficiently often described here and everywhere, there is no need for us to enter further into them here.

Fig. 3, which shows the details of construction of the transformers made at the Oerlikon Works, under the direction of Mr. Brown, explains the essential principles of these transformers, which are constructed to transform, when fully charged, the 200 kilowatts which the dynamo is capable of producing. We see that the fine wire circuits are entirely enveloped by the thick wire circuits, and that the three extremities of these fine wires pass out of the transformer in three thick glass tubes, so as to avoid any accidental metallic contact between the cast iron casing containing the petroleum, and the high tension wires. This casing is, moreover, connected to earth, and with the neutral wire, and can be touched with impunity during the transmission. A tap placed at the bottom of the cast iron casing enables the oil to be drawn off from the transformer before it is taken to pieces for the purpose of examination. All the connections are external, so that the couplings can be effected without interfering with the apparatus.

We can see by fig. 1 that in consequence of the connections established between the neutral points of the dynamo, and of the transformers which are connected in a star, that the whole circuit is in metallic communication with the earth. This mode of coupling, which is used exclusively for triphased alternate currents, increases the safety of the installation and reduces the danger at those points where the high tension wires enter the transformers, and along the wires themselves. The fatal accident which happened at Lauffen, a few days before the closing of the Exhibition, can only be attributed to the imprudence of the victim and to the violation of the regulations forbidding both the public and the Exhibition staff to come within reach of the dangerous high tension points.

The transformers insulated by means of oil will not necessarily be employed in all transmissions of energy by polyphased currents. Dry transformers are also being constructed at 3,000, 4,000, 5,000, and even 10,000 volts; for instance, those of Mr. Ferranti, at Deptford, for simple alternate currents. The same can be done for polyphased alternate currents. The construction, therefore, can be simplified when the tensions do not exceed these figures, and the insulating liquid dispensed with.

LINES.

The high tensions of polyphased alternate currents compel us to have recourse to overhead lines specially insulated. The Lauffen-Frankfort experiments will afford us valuable information with regard to the quality of these lines, and we await the results of the experiments of the Commissson with some impatience and curiosity, but it seems now to be universally acknowledged that the employment of large oil insulators with three cups involves a number of useless precautions. The insulators with a single cup, of the Johnson and Phillips type, seem all that is required, and have not up to the present given rise to any inconvenience.

We will not here discuss the transport of energy at a high potential by underground tri-cables; it is to be feared that their high price would prevent their employment, as they would add so considerably to the expense of the installation as to render all the economical advantages of transport to a great distance of no account.

As to canalisation at low tension, it is similar to that of continuous currents or ordinary alternate currents, and with the exception that three conductors are employed instead of two, differs in no way from it, so that we need not discuss it further. In the next article we shall treat of the application of these currents to lighting and motive power.

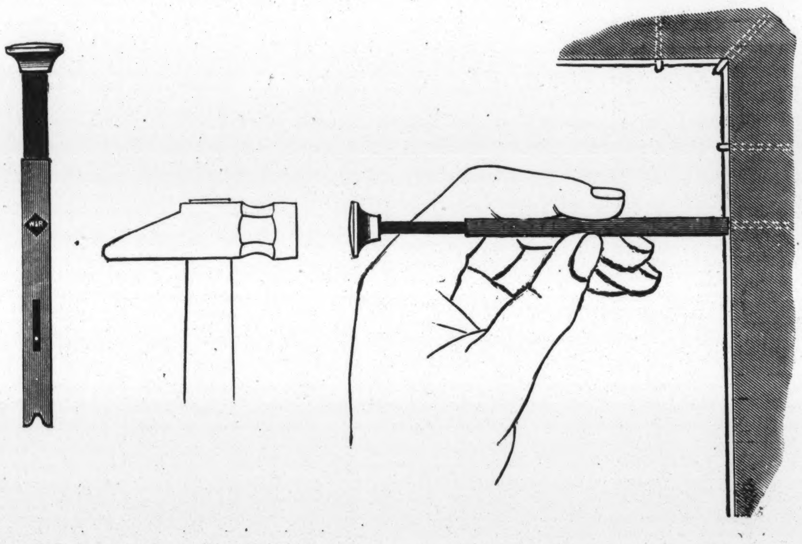
E. H.

"W. & R." PATENT STAPLE DRIVER.

THOSE who have had much experience in running bell wires, have often wished for some easy method of holding staples in position, without using one's own fingers for the purpose.

We illustrate below a simple little instrument, which has been designed with this end in view. It holds the staples in position until they have penetrated far enough to be driven home with the hammer.

The tool consists of a rectangular tube of a size suitable for the staples being used, in which is a plunger with a movement of about half an inch. The staple is placed in the end of the tube, where it is held, and the projecting points are placed over the wire, which is being run; a blow is given to the opposite end of the plunger, after which the tool is removed, and the staple driven home.



It will be found very handy for those who are in the habit of running wires overhead, or in other places where it is inconvenient to hold the staples in the fingers.

These particulars are supplied to us by Messrs. Woodhouse and Rawson United, Limited, from whom the tool may be obtained.

THE DYNAMOS AT FRANKFORT EXHIBITION.

By W. B. ESSON.

IV.

FACING the principal entrance was the 400 kilowatt Ganz alternator of the Helios Company, of Köln, shown in fig. 19. This machine runs at 125 revolutions per minute and gives 200 ampères at a difference of potential of 2,000 volts being capable of supplying current for 6,000 glow lamps of 16 C.P., as a placard placed conspicuously by its side informed the visitor. The armature is keyed, the rotating wheel which carries the radial magnets being fixed on the crankshaft and forming the flywheel of a 600 H.P. horizontal compound condensing engine by Paucksch of Landsberg. The armature consists of 40 T-shaped sections built up of soft-iron punchings, as shown in fig. 20. These sections are supported by a couple of strong cast iron rings to which they are bolted, and when placed in position form a laminated iron ring with 40 interior radial projections, having wound on each an armature coil. Each coil furnishes 100 volts, the 40 being coupled in two parallels of 20 in series. Any section with its coil complete can be removed without disturbing the others, while the side brackets projecting from the supporting rings rest on a slide bed and the whole armature by turning the large hand-wheel seen to the extreme right in fig. 19 can be moved parallel to the shaft and quite clear of the magnet wheel. The magnets are formed of U-shaped pieces of soft-iron, as in fig. 20, which are interlaced and clamped between a pair of heavy cast-iron discs to form a wheel with 40 laminated spokes or projections. The magnet coils are slipped on the spokes and secured against centrifugal force by brass angle pieces solidly screwed into the iron. The magnet wheel measures over the tips of the spokes 299·2 cm. and the magnets are about 38 cm. wide. Between the magnet spokes and the armature cores there is a clearance of 12 mm. The magnet coils are coupled in four parallels, and the power required to excite the machine at full load is 10,000 watts or 2·5 per cent. of the output. This at the time of the writer's visit was supplied from a secondary battery. The loss in the armature due to copper resistance is 2·0 per cent. By determinations made as carefully as possible by indicator diagrams, the loss from hysteresis, friction, air churning, &c., was found to be 18,500 watts, corresponding to 4·7 per cent. of the output. Assuming these figures as correct and the stray power so measured to have the same value at full load, the commercial efficiency comes out at $\frac{100}{109\cdot2} = 91\cdot5$ per cent., while the electrical efficiency is $\frac{100}{104\cdot5} = 95\cdot6$ per cent. The engine cylinders which are some distance apart, consequent on the room required for the lateral movement of the armature, are 57 cm. and 103 cm. diameter respectively, the stroke being 84 cm. The air pump levers are worked from the back end of the low pressure piston rod, and the governor acting upon the steam admission to the high pressure cylinder is similar to the well known Armington and Sims governor. In addition to the alternator just described, a smaller one of similar design giving 80 kilowatts is also shown.

The largest of the direct-current machines exhibited by the Helios Company, is shown in fig. 21. It is shunt wound and gives 400 ampéres at 110 volts or 44 kilowatts, the speed being 375 revolutions per minute. The armature is 45 cm. in diameter, and its core is built up of soft iron discs ·5 mm. thick, insulated from each other by paper and furnished with teeth to form Pacinotti projections on the exterior. The winding is in 52 sections, and the connections to the commutator are made so that the collecting brushes lie horizontally. The bearings are provided with a continuous lubricating arrangement which consists of a brass ring revolving loosely

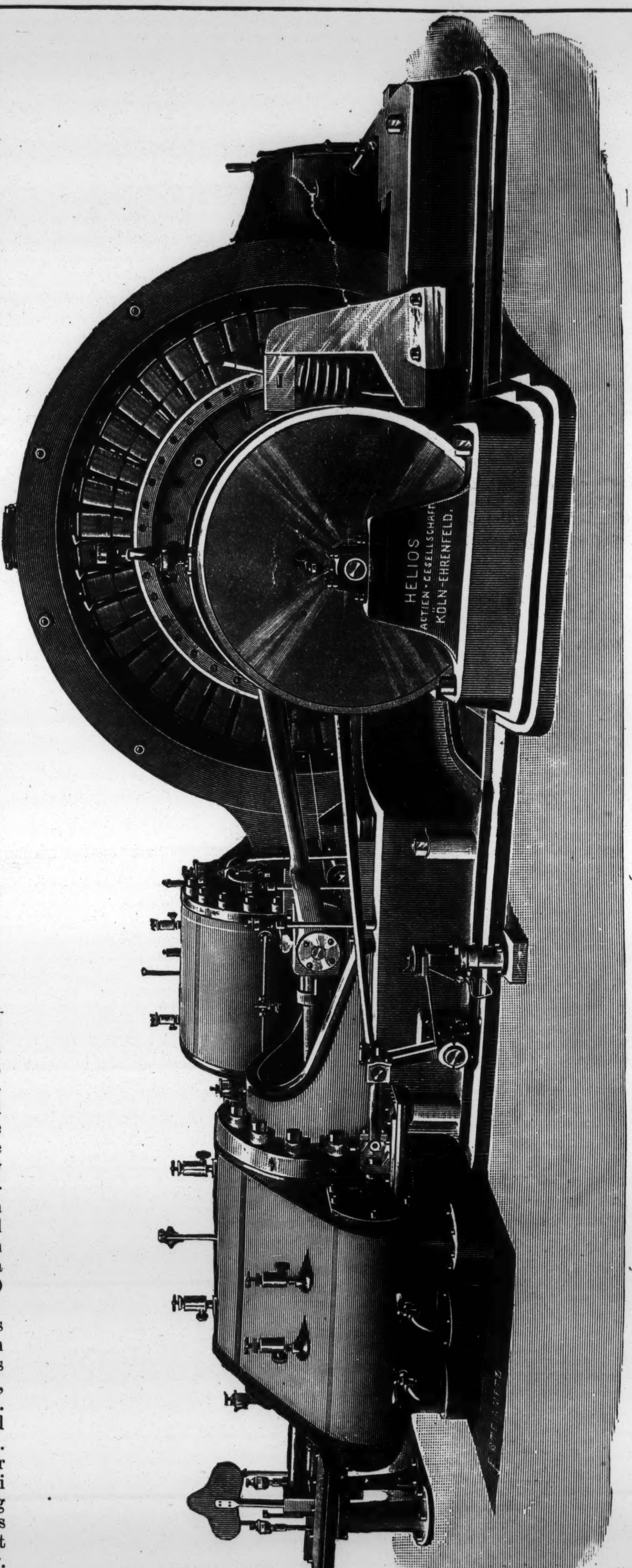


Fig. 19.

upon the journal, with its lower side dipping into an oil well.

The magnet is a single horse-shoe, and the limbs are of wrought iron cast into the bed plate. The two limbs are strapped together top and bottom, as shown in the sketch fig. 22, the bottom straps being with the lower ends of the limbs embedded in the casting. The power required to excite the magnet is 670 watts, which produces an induction in the armature of 15,000 C.G.S. lines per square centimetre. The loss due to the copper resistance of the armature is 1,120 watts, the electrical efficiency being therefore 96 per cent. The stray power absorbed by hysteresis, brush friction, air churning, &c., is 1,100 watts, which makes the commercial efficiency 93·8 per cent. The watts per kilogramme of armature copper are 650, the watts per kilogramme total copper on the machine 170, and the watts per kilogramme total weight 10.

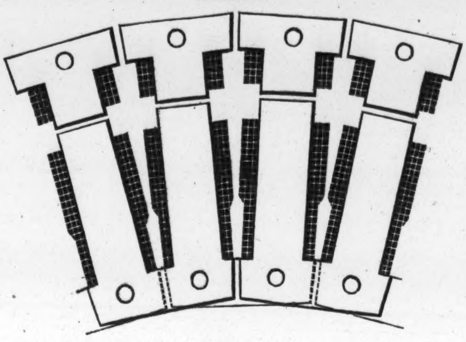


FIG. 20.

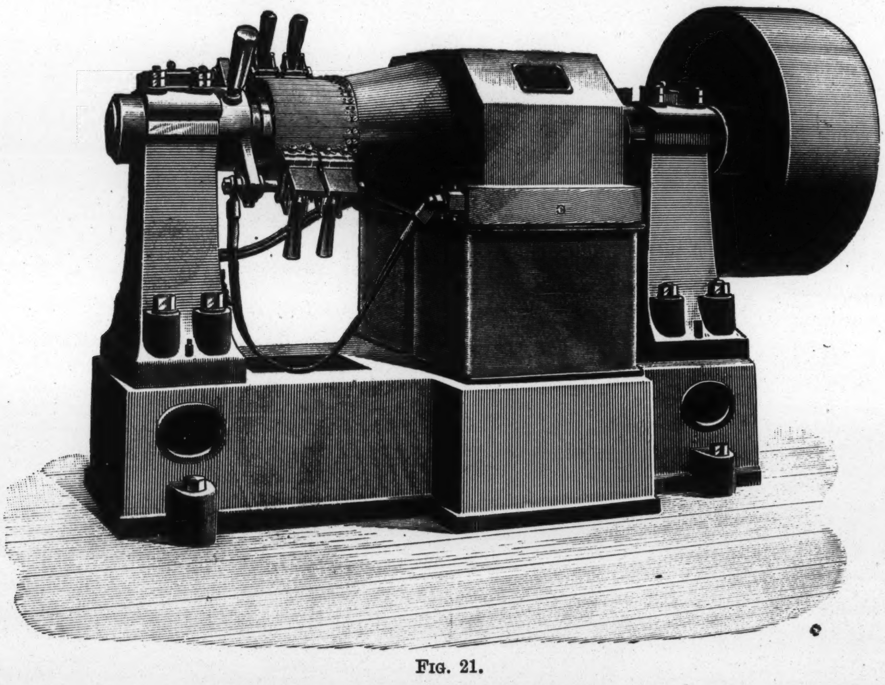


FIG. 21.

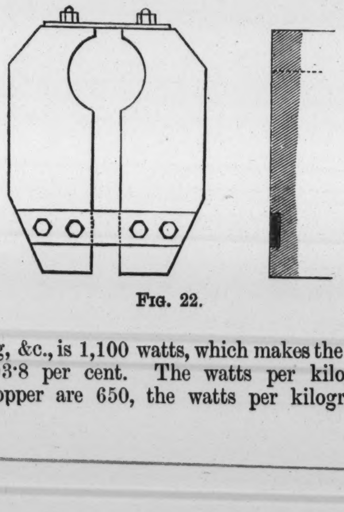


FIG. 22.

Another dynamo of the single magnet type, running at 450 revolutions and coupled direct to a vertical engine, was shown by the Helios Company. This machine gives 20 kilowatts at 130 volts for charging accumulators, and to keep the bearings low the horseshoe is inverted, having the yoke at the top. It is remarkable chiefly on account of its magnet being built up of sheet iron, as well as its armature, this construction having been adopted by the company for their small two-pole machines and their large four-pole ones.

Messrs. Woodhouse & Rawson exhibited one of their 70-kilowatt Kingdon alternators driven by belt from a Ruston and Proctor horizontal engine. To suit the conditions under which it had to work the armature coils were coupled up to give 640 ampères at 110 volts, the speed being 375 revolutions per minute. Under the ordinary conditions of high tension working this size of machine would be wound for a current of 32 ampères at 2,200 volts. The alternator is of peculiar construction, inasmuch as both magnet and armature coils are wound on cores projecting inwardly from the same laminated ring. In the ELECTRICAL REVIEW of March 20th, a general view of the machine was given, but some alterations have since been made, and, in fig. 23, the arrangement of the coils and part of the inductor wheel of the machine at the Exhibition are shown in section. The outside laminated ring is 171 cm. diameter by 30·4 cm. wide, and is built up of a number of sheet iron segments 1·07 mm. thick, separated from each other by tissue paper and arranged so that adjacent plates break joint. These segments are furnished with radial teeth N, A, S, B, &c., fig. 23, and the completed ring has 32 cores projecting inwards. Bolts of mild steel passing through the segments clamp the whole firmly together between two strong cast iron side frames which carry the shaft bearings. Alternate projections are wound with magnetising coils and polarised N and S as marked, while the intermediate projections, A, B, C, D, are wound with armature coils. On each of the 16 magnets are wound 144 turns of double cotton-covered flat copper strip 5·1 mm. wide by 1·6 mm. thick, the 16 coils being joined up in four parallels of four in series. The exciting current is furnished by an Elwell-Parker upright dynamo giving 80 ampères at a difference of potentials of 60 volts. On each of the 16 armature coils are wound 44 turns of copper strip similar to that on the fields, each coil giving 40 ampères and 110 volts and all being coupled in parallel to give 640 ampères. The inductor wheel is 135 cm. diameter and carries 16 blocks of laminated iron, I, I, formed by laying together sheet iron punchings 1·07 mm. thick, of the shape shown. These sheets are separated from each other by tissue paper and are clamped by mild steel bolts between a pair of steel plates, S, P, these latter being bolted in turn to a strong cast-iron centrepiece, C, I, keyed on the steel driving shaft. As the inductor wheel rotates lines of force are caused to flow through the armature projections from the N and S magnet projections alternately, which thus generates in the coils wound on the former an alternating E.M.F. In the alternators previously described we have had the armature fixed and the requisite periodic variation of the lines of force through its coils has been obtained by rotation of the field magnets on which the magnetising coils have been wound. In this alternator the armature is also fixed, but the magnet coils remain stationary as well. The relative variation of the field is not obtained here by moving the magnets as a whole, but by the device of moving a portion of the magnet core, this being virtually the function performed by the inductor wheel.

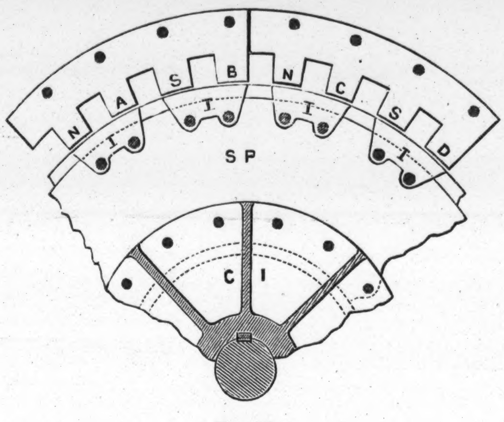
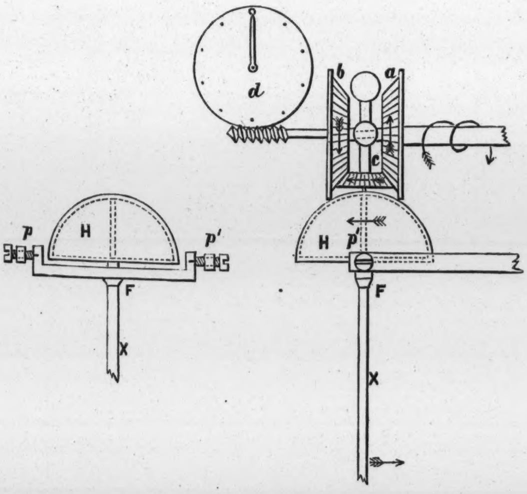


FIG. 23.

(*To be continued.*)

EBEL'S COULOMB METER.

THE feature of this meter is the differential gearing. Two crown wheels, *a* and *b*, are placed to face each other on the same axis, of which *b* is allowed to turn freely, and *a* is coupled to clockwork, from whence it obtains its driving power. H is a hemisphere made of a light substance, free to turn on its vertical axis, and is moved by frictional contact with the wheel *a*, by means of which it communicates its motion in the same way to wheel *b*, turning this wheel in the opposite direction. This hemisphere, H, in addition to the vertical motion already described, has another motion which has its centre in *p* p^1. The carriage, F, is free to turn on the fixed pivots, *p* p^1, and carries the pendulum, *x*, whose lower end is in connection with the ammeter which imparts an oscillating movement to it. C, a small planet wheel, free at the same time to turn on its axis, is in gear with the two crown wheels, *a* and *b*, and evidently if these two wheels rotate with the same velocity the planet wheel will keep its position, and is only allowed to turn on its centre, but if either of these wheels are driven with a greater speed, then the planet wheel will be carried onwards bodily in the direction of the wheel having the greater velocity.



When the pendulum, *x*, is hanging in a perpendicular position, the hemisphere imparts the same speed to the wheel *b* as it receives from *a*, but when the ammeter is affected by a current an oscillating movement of the pendulum takes place and alters its vertical position carrying the hemisphere to an angular one, thus changing the velocity of the wheel *b*. The motion of the planet wheel is transmitted to a registering arrangement, *d*, indicating the difference of speed of the crown wheels.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, CARDIFF, 1891.

DISCUSSION ON UNITS OF ELECTRICAL MEASUREMENTS.

The Sections A and G met for a joint discussion on electrical units, on opening the proceedings,

DR. OLIVER LODGE said: There are a good many things to be said about units at the present time, both mechanical and electrical. I think it will be for the convenience of the section if at the beginning of the discussion we attend principally to the electrical units, and to those units which are of established interest to engineers, and leave the more academical and mechanical units to a later period. With regard to electrical units, one of the most pressing things is the determination of an authoritative statement or agreement as to the coefficient of induction, not only self-induction, but also mutual induction. Now we know that already a great many names have been suggested for this unit. The mere name of the unit is, of course, very unimportant from some points of view, but it is not wholly unimportant whether this unit shall be called secohm or quadrant, or by the name of some man. Henry, mac, and other names have been suggested. The name, secohm, has certain advantages, in that it indicates the relation between this unit and the ohm-second, but there are certain disadvantages in that it tends to express the more simple by the more complicated. It expresses the unit self-inductance as being derived from the ohm, whereas the determination of the ohm itself is based upon a measurement of inductance; instead of describing the self-inductance unit as an ohm multiplied by a second, it would be more logical to call the unit of resistance a self-inductance divided by time. In all methods of determining the ohm, some form of coefficient of induction is the length that enters into the expression. If it is to be called a quadrant, it must be remembered that a quadrant is strictly an angular measure; and even though it be understood as short for earth-quadrant, and therefore a length, still it is not unobjectionable, for it is pretending a thing to be a length when it really is not a length. I think it would be a backward step if we fix it for all time as a length. On the whole, I should suppose that some name of less obvious meaning might be desirable, such as the name of a man. Now directly we permit ourselves to regard the name of a man as a possible name to be attached to the unit, we have the field open to consider. We are no longer compelled to make it equal to a secohm: it may be a sub-multiple. Now let us consider whether the secohm is a convenient size. The C.G.S. units were a connected system, or might have been a connected system, before any practical units were invented. Practical units were invented for this reason, that C.G.S. units were not a reasonable size, they were a million times too big or too small. It was out of the question for engineers to be always speaking of powers of ten. Now a secohm is rather big for a practical unit. Very few people—I speak under correction—have to deal with coefficients of induction of more than a secohm. The question is whether it would not be better, therefore, to make our practical unit some sub-multiple, say a thousandth, or something of that sort. We have a consistent system in the C.G.S.; there does not seem adequate need for two consistent systems. I regard it as more important to have the practical units of convenient size, than to have them most simply related among themselves. The farad has been useless, by reason of the neglect of this idea. The whole object of a practical system is to have units of convenient size, otherwise the C.G.S. would be all that is necessary.

The next unit wanted is a practical unit of magnetic field, or the unit of magnetic induction. Let me just explain what I mean by a practical unit of magnetic field. There is a C.G.S. unit, and it has not at present had a name given to it, although sometimes names are used, but it is too small for engineering purposes; it is something comparable to the intensity of the earth's magnetism. The total intensity of the earth's magnetic field is about half of one of these units. The magnetic fields with which engineers have to do are usually enormously greater, hundreds or thousands of times. Moreover, the definition of C.G.S. magnetic field is not one which immediately applies to engineering practice. We do not deal with a unit magnetic pole; and although it serves fairly as a fundamental unit for theoretic purposes, it is not very practical. Now consider how magnetic fields do come in; they come into engineering practice in the case when you have a coil of wire rotating in such a field. You have a certain area through which a number of lines of force pass; each complete revolution of an armature coil cuts the total lines of force four times, and the voltage which you can get is just equal to the rate of cutting of those lines of force. That is to say, if N represent the total number of lines of force passing through a coil, what would be called total magnetic induction through the coil, and if

$$e = \frac{d\,N}{d\,t}$$

this gives the voltage; of which the value at any instant is the rate of the change of the magnetic induction. That is the fundamental formula of magneto-electricity. It contains almost the whole philosophy of the dynamo. Here is another formula which contains the whole philosophy of motors.

$$d\,w = C\,d\,N.$$

The work done during any operation is equal to the current multiplied again by the change in the magnetic induction: the power being $P = e\,C$. It would seem as well to have some practical name for this quantity, N, so constantly occurring: the total lines of force, or the magnetic induction. As for magnetic field, that is related to this quantity in the simplest possible way; for it is the number of lines of force through unit area.

Whether the name shall be given to intensity of field or to magnetic induction—there might be a name for both—the relation between them is quite simple. The important thing to point out in most cases in practice is, that N is related to the coefficent of self-induction in a very simple manner. Suppose you have a closed solenoid, sectional area A, length l, permeability μ, number of turns n, what is the total magnetic induction caused by a current, C, in that solenoid?

$$N = \frac{(4\,\pi\,\mu\,n^2\,A)}{l}\,C$$

It merely requires a slight modification to make it applicable to dynamo magnets and other things. I only quote the expression in its simplest form. There are more complicated similar forms, but in all cases the induction caused by a coil's own current, or the true "self-induction," is equal to *something* multiplied by C; and that something essentially is the coefficient of self-induction, or the inductance, a thing which is commonly denoted by L. So the above expression is simply $N = L\,C$. Hence, if we have a name for the coefficient of self-induction we have a name at once without any trouble for the total magnetic induction through an area.

I do not wish to call it any particular name, but supposing *mac* were the unit of self-inductance, then the unit of current being an ampère, the unit induction would be a mac-ampère; thus we should have a name at once for the total magnetic induction, and when you want to express the intensity of a field it would be a mac-ampère per square centimetre. Another name for unit induction is a sec-volt, which is plainly equal to a secohm-ampère, or, as I have just called it, a mac-ampère. Perhaps sec-volt is a good name: of course it is the number of lines of force which if cut in one second gives, in the cutting circuit, an E.M.F. of 1 volt.

Mr. W. H. **PREECE** said: The work of the British Association Committee on Electrical Standards has now extended over 30 years. Its first report was issued in the year 1861 at Manchester, and we have, after a great deal of difficulty and trouble succeeded in impressing those units of measurement, not only upon the scientific world of England, but upon that of all countries. During this last year a Committee appointed by the Board of Trade has taken into consideration the work of the British Association Committee and has come to the conclusion which will result, in the month of November, of an order in Council being passed making the ohm, the volt, the ampère, and the farad legal standards, such as will for years to come be regarded as the stable standard measurements in England. Now having run in a groove for 30 years and having succeeded by dint of great labour in impressing these units on others, I am afraid we are running our heads against a brick wall when we attempt to produce any change upon such a system. Nevertheless, while the difficulty of producing a change is very great, I am going to have the temerity of suggesting a change in another direction, in addition to that suggested by Dr. Lodge. While there is a difficulty in making a change, there is also a difficulty in impressing new ideas into our language, although absolutely essential. New wants arise and we must have new names to express these new things. The fashion to introduce new meaningless words, has practically failed. They tried to thrust upon us the term *barad* as indicative of the standard of pressure, *bole* the unit of momentum, and *kine* the unit of velocity, but I think this attempt has practically failed, and I have met but one case where one of these names was used, and then it was spelt wrong. I am a great advocate for the use of words based on names. They enable us to pay a grateful compliment to those who have passed away. They enable us to attach a useful word to something that requires great precision of thought. The use of such words as ohm and volt and ampère almost render definition unnecessary, and in some cases they remove great difficulties, for I am sure if there was a mistake made by students and by professors sometimes, it was in drawing distinction between "power" and "work." Now we have introduced two words, watt and joule; watt as the unit of power, and joule as the unit of work, and I think I can confidently state that nobody since the introduction of these words has made the mistake of confusing power with work or work with power. So, I say, words clearly indicating these standards are very useful and valuable. We have several names from which we might draw. We have Gilbert, we have Gauss, we have Weber, we have Franklin, Henry, Maxwell. These names are valuable, and certainly there are some units to which they might be very well applied. I have mentioned the names of men who are dead, for I think it would be unwise to affix the name of the living, and though there is one whose name will be associated with the electrical units some day, it is perhaps better for the present to stick to the old. There are more names wanted still. Prof. Lodge has alluded to the unit of magnetic field or force, and there is not the slightest doubt that the time has arrived when we must adopt the unit of magnetic field, and we must give that unit a name. Some have proposed that this unit shall be based on the C.G.S. unit alone, others have suggested that it should be 10 to the power of 8, and I am going to propose that it should be called 10 to the power of 9. The reason why I suggest that change is depending on another alteration that I am going to suggest, that the volt should be 10 to the power of 9, instead of 10 to the power of 8. That matter is dealt with in a paper by Professor Stroud, and I would rather adhere to this point only now, because he will in his paper deal with the matter very thoroughly. 10 to the power of 8 was selected by the original committee solely because 10 to the power of 8 was the nearest approach that we could find to the Daniell cell. That cell was *then* universally applied, but it is now surpassed by others such as the Léclanche or bichromate, the E.M.F. for which is much higher. One great reason I propose that the value shall be 10 to the power of 9 is that it makes the Farad the same in C.G.S. as in practical units. I should very much like to have said something on dimensions, but I want to refer to one other unit that requires to have names attached, that is H. There was a time when there was a great demand for unit magnetic pole, but that time has long since passed, and Dr. Lodge himself has referred to induction to N, more particularly in its form per square centimetre, and called B density of field. There are two great quantities that are most important in electrical developments of the present day, and that require a great deal of sifting, not that we can find units for them, one is μ, the other the coefficient of specific inductive capacity, sometimes K, then we come to L, the coefficient of self-induction. I said yesterday that there is more nonsense talked about self-induction than upon any other branch of electrical science. There are those who talk about self-induction who have had very little practical experience of its effects, who have applied self-induction sometimes to a geometrical quantity, sometimes to permeability, and sometimes to the whole induction. It has been my practice for some years never to speak of self-induction, because it is mixed up so dreadfully, but always to speak of electro-magnetic inertia, and that is the term we have met with in practice which is familiar to us; when we find writers misusing this term self-induction it makes one regret that we have not a unit for this term to centralise one's ideas and to avoid friction. I am at one with Dr. Lodge when he proposes a unit of self-induction. Nobody has proposed a better name than that of Henry. 10 to the power of 9 was a very good unit indeed and if they had this unit 10 to 9 they would wipe out the use of the word secohm. The system of units now used is absolutely artificial, and conventional. I will not occupy your time with dealing with the relations between H and various other quantities. The name of Gauss had been proposed, in fact it was proposed in Paris. If there were two men whose names ought to be used as units one was Gilbert and the other Gauss, who had done so much to establish the absolute system. We want to know the value of K and R. Perhaps Prof. Rucker, who has worked in this direction would do something more. We want something more than dimensions; we want a table of specific resistances. At the present moment we have really only the specific resistance of mercury and of copper accurately determined. We also want a new determination of J. A better mode by which the mechanical equivalent of heat could be arrived at. They wanted to get rid of the obnoxious table of dimensions that every text-book is laden with. In Maxwell's great work there are three or four different systems of dimensions, and in engineers' pocket-books, which were supposed to contain useful facts—pages after pages are filled with these useless dimensions. In conclusion the speaker said he should be very sorry if any conclusion that this section should come to should interefere with the acceptance of the ampère, ohm, and farad, as the legal standards. If it were to go abroad that they were disunited it might perhaps tend to the withdrawal of the order in Council. He thought we should certainly succeed this year in getting these standards made legal, and then these standards will be the legal standards of the world.

PROF. W. STROUD then presented "Some Revolutionary Suggestions on the Nomenclature of Electrical and Mechanical Units," of which we give a summary:—

1. The present practical system of units is very objectionable on three grounds:—

(α) There is no primâ facie reason why the practical unit of current should be equal to $\frac{1}{10}$th C.G.S. unit.

(β) The relation between the other practical electrical units and the corresponding C.G.S. units is much more complex than need be.

(γ) The units of work and power are far too small for practical requirements.

2. If we were starting to devise a practical system to-day, such a system could best be formed by taking 10^9 cm. as the unit of length, 10^{-9} gm. as the unit of mass, and the second as unit of time.

3. That in the interests of the "practical" men of the future and in the interests of the electrical students of both the present and the future, it is highly desirable to institute a revolution with the object of dethroning the present practical system of units.

Nomenclature.

1. That the term *Dyne* to indicate 10^7 of our present (1891) dynes

is objectionable, as custom has restricted the use of Greek derivatives entirely to C.G.S. units. That 10^7 dynes, *if required*, should be called a Hebdomodyne, suitably contracted of course, or preferably a Joc (joule over centimetre).

2. That the classical languages are of little or no service for the provision of names for modern, more or less complex, physical conceptions; and therefore this method of coining words it is desirable to abandon.

3. That for C.G.S. units some system of *automatic nomenclature*, in which every name shall be self-explanatory, would prove a boon to the teacher and a blessing to the student, and that such a system is quite capable of being devised.

4. That the prefixes *meizo*, to indicate 10^9, and *mei*, to indicate 10^{-9}, may be found useful.

Mr. Swinburne in continuing the discussion, said he was rather inclined to think it would be better to stick to the old units. He did not think Section A realised the enormous difficulties that they put in the way of practical people by making alterations. The alterations in the ohm produced a great deal more trouble than will be yet realised. He might say with regard to self-induction that it would not spread much in practical work. His firm made a great number of transformers, and it was necessary to make these with great accuracy, but he did not believe anyone in his place could tell in secohms what the self-induction of the transformer was. In regard to names, he would hope that the name of Poggendorf would not be left out.

Dr. Johnstone Stoney said on this question, at the present day, he was a complete conservative. He would wish to see the ohm system of measurement maintained intact, and he believed that only practical mischief would result from any attempts now to diverge from the ohm system. He was a member of the committee which fixed the C.G.S. system of measurement recommended in 1874, Prof. Carey Foster being another. On that committee there were some members who had long practical acquaintance with the metrical system of measurement, but there were other members who had only immediately before been converted to the opinion that the systematic system of units ought to be based on metric measures, and who had had little practical acquaintance with it as a working system. He (the speaker) dissented from the selection that was made on grounds totally different from those attributed to him in Prof. Everett's book. He would wish to take this public occasion for stating that the original note which Mr. Everett put in the first edition, and the subsequent note in the second edition, did not in the least represent what he stated at the committee. No systematic system of units could have been framed without some electrostatic and electro-magnetic units belonging to it being inconveniently large or small; but it was quite unnecessary to make a selection which led to the same defect prevailing among the dynamical units. What he (the speaker) had objected to was choosing such fundamental units as led to a unit of force so inconveniently small as the dyne (about the weight of a milligram), a unit of energy so small as the erg (about the hundred-thousandth part of a gram-metre), and a unit of power which is the ten millionth part of the watt. The definite proposal he made to the committee was, that the metre should be the unit of length and the kilogramme of mass; but he would have concurred in recommending any selection of fundamental metric units which would have led to convenient dynamical units. With respect to the unavoidable size and minuteness of some of the electrical units, he suggested that a nomenclature should be introduced which would make it easy to use in practice any decimal mul-

Stoney's Table of the Relations Between Electric Units.

			Dynamical dimensions.	Electrostatic dimensions.		Electrostatic.				Maxwell, Unit of		Electro-Magnetic.				Electro-Magnetic dimensions.
						G.G.S. Unit of		Ohm Unit of				Ohm Unit of		C.G.S. Unit of		
Quantity.		Of Magnetism ...	...	α	*	p′	10 >	p	=	p P	30 >	Gilbert	10^8 >	P′	*	$v\alpha$
		Of Electricity ...	...	$v\alpha$	*	q′	10^8 <	q	30 <	q Q	=	Coulomb	10 <	Q′	*	α
		Of Mass	$\frac{\alpha^2}{L}$	...		m′	10^{11} >	m	30 >	M	...	...	...	...		...
		Of Volume	L^3	...		b′	10^{27} <	b	30^3 <	B	...	...	...	...		...
Electric Current			...	$v\beta$	*	a′	10^8 <	a	30 <	a A	=	Ampère	10 <	A′	*	β
Energy-factors.	Potential at each point of space.	On Magnetism ...	...	$v\beta$		v′	10^8 <	v	30 <	v V	=	V	10 <	V′		β
		On Electricity ...	...	β	*	v′	10 >	v	=	v V	30 >	Volt	10^8 >	V′	*	$v\beta$
		On Mass	v^2	...		V′	10^{18} <	V	30^2 <	V	...	...	...	...		...
		On Volume	$\frac{\beta^2}{L^2}$	...		V′	10^{20} >	V	30^2 >	V	...	...	...	...		...
Force-factors.	Potency at each point of space.	On Magnetism ...	...	γ	*	g′	10 >	g	=	g G	30 <	Gauss	10^{10} <	G′	*	$\frac{\gamma}{v}$
		On Electricity ...	...	$\frac{\gamma}{v}$		g′	10^{10} >	g	30 >	g G	=	G	10 <	G′		γ
		On Mass	$\frac{v}{T}$	...		g′	10^9 <	g	30 <	G	...	...	...	...		...
		On Volume	$\frac{\beta^2}{L^3}$	...		g′	10^{29} >	g	30^3 >	G	...	...	...	...		...
Tubes of Force [the number of which per unit area = Potency.]		Magnetic	...	$v^2\alpha$	*	n′	10^{17} <	n	30^2 <	n N	30 >	N	10^8 >	N′	*	$v\alpha$
		Electric	...	$v\alpha$	*	n′	10^8 <	n	30 <	n N	30^2 >	N	10^{17} >	N′	*	$v^2\alpha$
		Mass	$v^2 L$	...		n′	10^{27} <	n	30^3 <	N	...	...	...	...		...
		Volume	$\frac{\beta^2}{L}$	...		n′	10^{11} >	n	30 >	N	...	...	...	...		...
Electric.		Resistance	...	$\frac{1}{v}$	*	r′	10^9 >	r	30 >	r R	30 >	Ohm	10^9 >	R′	*	v
		Coefficient of Self-induction }	...	$\frac{L}{v^2}$	*	s′	10^9 >	s	30 >	s S	30 >	S	10^9 >	S′	*	L
		Capacity	...	L	*	c′	10^9 <	c	30 <	c C	30 <	Farad	10^9 <	C′	*	$\frac{L}{v^2}$
		Specific inductive capacity }	...	o	*	k′	=	k	=	k K	=	K	=	K′	*	o
						E [Voltage, or electromotive force], identical with potential *on electricity*.										

In the columns of dimensions $\alpha = \sqrt{LM}$, $\beta = \frac{\sqrt{LM}}{T}$, $\gamma = \frac{\sqrt{LM}}{T^2}$. The Units of L, M and T for the Maxwell column are so selected that the unit of v becomes in it the velocity of light, and that the units of α, β and γ remain the same as in the ohm columns.

* Asterisks are introduced to direct attention to the more important of the horizontal lines.

tiples or sub-multiples of them. For instance, they had got the farad, a unit of capacity too large for any practical purposes; accordingly, the practice was to make use of the microfarad, as it was unfortunately called. He would prefer to call it the 6th farad (the farad divided by 10^6). It is a very convenient measure for measuring the capacity of submarine cables and in cases where large capacity had to be dealt with; but if they wanted to measure the capacity of an ordinary Leyden jar it would be a great deal better to measure it in 10th farads instead of 6th farads. This nomenclature would enable one to use the 10th farad when convenient, and the 6th farad when convenient, and would tell exactly their relation to one another. To deal with multiples, and in order to make the distinction between sub-multiples and multiples as great as possible, he proposed that the tenth metre should mean sub-multiple, and that the metre-ten should mean multiple, and so on. That system of dealing with the multiples and the sub-multiples would be a very great practical convenience to electrical engineers. It would also avoid entirely the necessity of following what, he understood, was the suggestion of the President, of using a unit for self-induction which did not belong to the ohm system. He certainly thought it would be a very retrograde step for the B.A. to abandon the fundamental principle of making all the measures belong to some definite systematic system. It was a misfortune that such a thing should occur as was mentioned by Mr. Swinburne, that artisans who were habitually engaged in making transformers could not tell in the least, in any definite system of measures, what the self-induction was. He believed it would be a very great increase of their capacity for doing real work if the use of measures at every stage was so facilitated that every artisan could have a clear perception of the measures he was using. Personally, he was averse to any revolutionary change, and although the C.G.S. system, he believed, was not the best that could have been selected, he should be sorry to see it interfered with in any degree now. He proposed an obvious and easy method for converting from electrostatic into electro-magnetic measures. There is no doubt for some purposes, electrostatic measures are more convenient to work. At present engineers were practically precluded from doing so in a case where it would give them a great deal of assistance by the difficulty of easily tracing the relation between the two. Mr. Preece seemed to have a great objection to dimensional equations. He (the speaker), on the other hand, would wish to see dimensional equations made so simple that they would come into very general use. The speaker here referred to the foregoing table, intended to facilitate the conversion of electrostatic and electro-magnetic measures into one another. The units in the central column of this table have been introduced, not with any intention of recommending the use of a new set of measures, but only as the natural bridge between electrostatic and electro-magnetic units, which assists the conversion of these into each other by making clear to the mind the numerical relation between them. He thought that the natural name for the unit of magnetism would be the Gilbert, who was the first man they could trace who had really studied magnetism, and the natural name for the unit of magnetic field would be Gauss. Poggendorf and some others had been mentioned, though if any name deserves the distinction, it is that of Weber, who was the first person to point out the importance of systematic units. There might be a difficulty in the way of this on account of the pronunciation. He would also very earnestly try to persuade the members of both Section A and Section G to the opinion that the time had fully come for getting rid of the dreadful misuse of the word force, as in the phrases electromotive force, magnetic force, &c. The speaker in conclusion said he did not like the word pressure, it suggested a misleading analogy. He saw no objection to the word voltage, which was very convenient for practical use and got rid of the false analogy.

Prof. Carey Foster, expressed his satisfaction at hearing the expression of Dr. Johnstone Stoney's conservative principles in the matter of nomenclature. If they were to have new standards they must employ a new name; they might employ a term derived from "Galvani," say "galv" or "gal."

Prof. Silvanus Thompson said, in relation to the unit of self-induction, that Dr. Lodge had stated that he did not see why its coefficient should be considered as a length, but it *was* a length, and Sir William Thomson had devised an ideal experiment illustrating the point. They needed that a physical fact should be discovered to enable them to determine the absolute value of k or μ.

Prof. T. H. Blakesley wished to introduce to the section a unit with which he had been greatly concerned; this was the particular one which was measured when a current was sent through one coil of a dynamometer, and another current through the other. It was the product of two currents. It was most important to arrive at the power per unit of resistance. At the Physical Society he had given many cases in which the application of the split dynamometer would be the most advantageous, and in some cases, such as the power lost in the revolutions of magnetism in the iron core of a transformer, it was practically the only way to arrive at it. He was very averse to giving the names of people, however eminent they might be, to units.

Prof. Andrew Gray thought the phrase "electromotive force" was unfortunate, but that it would cause much inconvenience to drop it. A clear distinction, ought, however, always to be made between *electromotive force at a point* (that is the *electric force*) and the electromotive force round a circuit. It would cause serious confusion if one word were used in two senses; if the word "force" were not used alone, but described at the time of speaking, he thought that not much disadvantage would arise. He trusted that more attention would be given to what was of greater importance than finding a name for the unit of inductance, viz., the calculation of coefficients of induction.

After a few remarks from Prof. D. E. Jones,

The President stated that time would not allow the continuation of the discussion; he hoped that it would be continued in the journals, especially as at present it was not quite clear what was actually wanted in practice.

Mr. Preece thought that it would be objectionable for the British Association to suggest any change in the principle of the unit. The farad was as immense as the universe, and the microfarad very small, but useful; he thought that it would be well to call the microfarad the farad, and that they should call the volt and ampère either the 10-volt and 10-ampère, or the *weber*.

NOTES.

Discovery of India-rubber Trees.—A party of explorers have recently discovered immense forests of the India-rubber tree in the valley of the Orinoco. They have also discovered other trees very much like, if not identical, with the gutta-percha trees of the Malay Archipelago. The latter being almost extinct now, the news is all the more important.

Electric Lighting at Norwich.—The prospectus of the new Norwich company for supplying electricity for lighting purposes and for motive power has been published. The capital is £50,000. Norwich citizens should take the matter up with spirit. An efficient electric light company may compensate for the deficiences of the British Gas Light Company. The public is asked to take shares.

Amendment of Patent.—The Woodfield Syndicate has applied for leave to amend the specification No. 16,623 of 1887, granted to W. T. Goolden and L. B. Atkinson, for "Improvements in dynamo-electric generators and motors." Further particulars can be seen in our advertisement columns.

Electricity Meters.—Inspector: "Something wrong with the meter, it has been very foggy for some time past and the meter has certainly registered too low; lets have the cover off and see what's wrong. Ah—mercury rather thick and dusty—just wipe it a bit, put a little oil on, and give it a twist and see that it runs freely; all right now." Report:—"Meter at X——— registering too low, had it very carefully adjusted and verified, left working correctly." (A fact! and probably many more like it).

Gas and Electric Light in Vienna.—The Imperial Continental Gas Association in Vienna, whose contract with the old Vienna authorities expires in 1900, and those with the suburban local powers partly terminate forty years later, has proposed to the greater Vienna authorities to enter into a new contract of long duration. According to this, the authorities would participate in the net receipts to the extent of 10 per cent. at first and 15 per cent. later, the association—an English company—agreeing to abandon the monopoly of street lighting in order to offer no obstacle to the introduction of the electric light in the streets.

The Ozokerite Mines of Galicia.—The failure has been announced of a firm belonging to a syndicate owning extensive ozokerite mines at Drohobiez. The firm's difficulties arose through some flaw in the title deeds, and it is stated that many other large firms in the district are in the same position. The ozokerite mines in Galicia are the largest in Europe. There are at present one hundred and forty-two, of which eighty-four are worked by between six and seven thousand hands, the yearly output being worth nearly three million florins. The ceresin and paraffin made from the Galician ozokerite, are exported to Russia, Germany, and England, the ceresin being the best substitute for beeswax, as well as costing half the price. This peculiar Galician industry is capable of considerable development, but the title deeds must first be regulated before the requisite capital can be forthcoming.

Electro-Harmonic Society.—On Friday evening next the second smoking concert of the new season will take place. The programme is a good one.

Why the Difference?—It is stated that for the electric lighting of a big building in the City, one firm tendered for £2,260 and another for £995.

Secondary Batteries.—Dr. Paul Schoop is describing the accumulators at the Frankfort Exhibition in a series of articles in our American contemporary the *Electrical Engineer*.

"Figaro's" Coming Men.—In the London *Figaro* for the 21st inst, Mr. F. L. Rawson is illustrated as one of the coming men. If the electrical fraternity were asked their opinions, the replies would probably be that he had "come" long ago. He might, however, have well been spared the reference to the Directorate of Elmore's Copper Company.

Advertising Novelties.—The latest striking novelty in advertisements, says *Industries*, is a glaring query which appeared in an American journal as to the Mosaic locus at the time of extinction of an old-fashioned illuminant. The answer is that Moses was all right; he switched on So-and-So's arc lamp. There is a picture of the gentleman completing the electric circuit, and the reader is led to infer that arc lighting first occurred soon after the flood subsided.

New Uses for Aluminium.—One of the most recent applications of aluminium is in the construction of sounding boards for stringed musical instruments. Sounding boards made of aluminium are said to possess an elasticity capable of sympathetic vibration uniformly through a wide range of tone pitch, which renders it superior to wood in this respect. It is reported that Messrs. Steinway are now constructing a piano with an aluminium sounding board, in order to test its practicability. Within the last few weeks a patent has also been taken out for the application and use of aluminium in the manufacture of bicycles.

Lighting the Mansion House.—The contract for wiring and fitting the City of London Mansion House has been given to the Planet Electrical Engineering Company, of 67, Piccadilly, W.; 700 glow lamps of 16 candle-power will be fixed, of which 232 are for the lighting of the Egyptian Hall. The whole of the premises are to be fitted, and the current will be taken from the mains of the City of London Electric Lighting Company. Preparations are being made to commence the work immediately the present Lord Mayor goes out of office.

Electrical Laboratory at the Glasgow Technical College.—Over ninety day students have entered for the electrical laboratory and engineering workshop courses at The Glasgow and West of Scotland Technical College conducted by Professor Jamieson and his assistants. In order to accommodate the increase in the number of day students, the workshops have had to be considerably extended and whilst one set of students are testing in the laboratory, others are practising jointing of electric light wires and submarine cables. It is interesting now to observe from how many foreign countries students have been attracted, viz.: India, China, Australia, New Zealand, Mozambique, South Africa, West Indies, Norway, &c., in addition to various distant parts of England and Scotland.

International Congress of Electricians.—Professor Carhart says: "Various movements have been set on foot with the object of securing the attendance of foreign electricians of note at the International Congress of Electricians, to be held in Chicago in 1893." He advocates that it should take place under the auspices of the World's Columbian Exposition, which would virtually mean Government recognition, and he concludes: "The only electrical congress of great importance, thus far held, was the congress at Paris in 1881. Its decisions have been universally accepted, and its influence on the progress of the science of electricity has been plainly apparent ever since. If this supreme opportunity, presented by the World's Fair in 1893, can be rightly laid hold of, the gathering of electricians in congress at that time may prove no less fruitful in results than that at Paris 10 years ago."

City and South London Railway.—The directors have decided to issue season tickets. It is also intended on and after November 1st to increase the fare from 2d. to 3d. between the hours of 8 and 10 a.m.

Interruption of Telegraph Lines.—The Great Northern Telegraph Company announce that the Japanese land lines beyond Hiogo and Osaka are interrupted owing to a severe earthquake which occurred at Hiogo and Osaka on Wednesday morning.

Hampstead Electric Lighting.—At last week's meeting of the Hampstead Vestry it was stated that a letter had been received from the London and Hampstead Electric Battery Company, stating that they had erected a station in the Finchley Road, also that they were prepared to give the vestry the opportunity of testing their powers for street lighting over a small area. The matter was referred to the Lighting Committee.

Preston and Electric Lighting.—As we briefly notified last week, the Corporation of Preston, growing dissatisfied with the lighting of the town by gas, have decided to enter into a three years' contract with the company for lighting the principal street in the borough. The system adopted is known as the "low tension," and contact of any kind with the wires is absolutely unattended with danger. The capital of the company is £100,000 in 19,900 ordinary shares of £5 each, and 100 founders' shares of £5 each. The present issue is £60,000, in 12,000 shares of £5 each.

Electric Lighting, Finchley.—At a meeting of the Finchley Local Board, held at their offices on Tuesday evening, 27th, it was finally decided to apply for a provisional order for the lighting of their district by electricity. An exhaustive report was submitted to them in June last by their engineer and surveyor, Mr. F. Smythe, in which he recommended the transformer system, with an alternating current, as best suited to the requirements of the district, and estimated the cost at £19,000. The price of gas for public lighting varies from 4s. to 4s. 6d. per thousand feet.

Gas and Electric Light in Paris.—A new scheme has been elaborated for the prolongation of the concession of the Paris Gas Company, which has almost a monopoly of gas lighting in that city. One point in the project, is to authorise the company to become a supplier of the electric light, but only by serving a "secteur" or limited district similarly to the existing electrical companies, and after the approval of the municipality. The gas company would have to comply with the same conditions and specification as have the electric light companies.

The Variation of the Electromotive Forces of Batteries under Pressure.—In a note contributed to *Comptes Rendus*, M. Henri Gibault states that the variation in electromotive force of batteries under pressure in cases where no gas is disengaged, may be expressed by a formula of the form

$$E_0 - E = a\,p - b\,p^2,$$

b being a very small quantity in cases where the pressures are not very great, the variation in fact being linear, which is in accordance with theory. In cases where gas is given off, the equation is

$$E_0 - E = A\,k\,p + c\,p,$$

c being very small; that is to say for moderate pressures the variation of force follows a natural logarithmic curve. The accord between theory and experiment is close, as may be seen by the following results:

Batteries.	Variations in $\frac{1}{10000}$ volt.	
	Calculated.	Observed.
Daniell (20 per cent. SO_4 *Zn*)	+ 5·17	+ 5
„ (27·56 per cent. SO_4 *Zn*) ...	+ 2·2	+ 2
Warren de la Rue (1 per cent. *Zn* *Cl*)	+ 6·62	+ 7
„ „ (40 per cent. *Zn* *Cl*)	+ 5·04	− 5
Planté Accumulator (8·8 per cent. SO_4 H)	− 12·7	− 12
Volta	− 586	− 600
Bunsen	− 383	− 405
Gas Battery	− 865	− 845

Electricity in Calico Printing.—The Société Industrielle de Mulhouse (France) is offering (amongst other prizes) a silver medal for the application in any form of electricity to calico printing. Further particulars regarding this matter can be obtained by applying to La Société Industrielle de Mulhouse, France, and all applications for the award should be sent in on or before February 15th, 1892.

A Stoker's Explanation of the Steam Engine.—"This 'ere furnace, gen'lmen, heats that 'ere water, and that 'ere water is in this 'ere biler; and that there pistern rod is moved up and down by the steam from this 'ere biler; and them 'ere pisterns acts upon them rods, which turns the axles of the paddles, and the paddles their selves in consequence."—From "Pickwick Abroad," by G. W. M. Reynolds.

Proposed Electric Trams.—We understand that the Sedgley, Dudley, and Wolverhampton Tramway Company are about to apply to the Board of Trade and the local authorities for sanction to use electricity in lieu of steam. During the last two years there has been great difficulty in running the engines owing to the steep gradients at Upper Gornal and Sedgley Hill.

The Electric Light in Brazil.—The electrical department of Empreza de Obras Publicas nos Brazil are just now devoting much attention to electrical matters, and is anxious to receive catalogues, &c., of electric lighting and power transmission plants, and also of telegraph and telephone apparatus. Any catalogues sent out should be addressed—Seccao Commercial Empreza de Obras Publicas nos Brazil, 60, Rue do Hospicio, Rio de Janeiro, Brazil.

Compensation for Injury.—At the Guildhall, on Wednesday, a workman named McGowan obtained a verdict for £150 against his employers, Messrs. Stephens, Smith and Co., the well-known electric launch builders, of Cuba Street, Millwall, as compensation for injuries sustained by the fall of a slab of iron, which he alleged was being moved in an unsafe manner. His foot was injured, and he had to undergo an operation which left him partially lame.

Huntingdon and the Electric Light.—The rooms of the Huntingdon Literary and Scientific Institution are now lit by the electric light. The main hall and library were brilliantly illuminated last week for the first time, when the annual *soirée* of the institution was held. The lighting, which was in every way successful, was carried out by Messrs. Baily and Grundy, of Cambridge. This is the first introduction of the electric light into Huntingdon, and it is to be hoped that the lighting by electricity of the Town Hall and other large buildings will soon follow.

Electric Lighting at Grays.—At a meeting of the Grays Local Board on Thursday, October 22nd, Mr. A. W. Boatman said he had been in communication with Messrs. Crompton & Co. for the purpose of ascertaining whether the machinery at the sewage pumping station could be of assistance in electrically lighting the district, and Messrs. Crompton replied that they would not advise such a utilisation of the pumping engines, as such an arrangement would be very expensive, and give a great deal of trouble in the working. The consideration of the matter was further adjourned.

Bell Telephones for Export.—Under this heading the *Electrical World* gives some information relative to the cost of the instruments in use in America. It appears that the entire cost of a phone and transmitter comes to $3.42, whilst the price exacted by the local exchanges for telephone service in the large cities of the United States ranges from $100 to $150. A complete set of two Bell telephones, two Blake transmitters, two call bells with backboards, battery cells and cords, can be had for $33. The outfit for a mile of line amounts to $13.25 (poles, of course, not included). It would thus appear that the profits which have been made on the business have been enormous, though, of course, these profits have not gone exclusively to one set of individuals, as there are many intermediate expenditures which have to be incurred before clear gain on capital can be estimated.

Chislehurst Electric Lighting.—The Chislehurst Parochial Committee have resolved to accord an interview to the Secretary of the Provincial Electric Light and Power Supply Company, Limited, in connection with the proposed electric lighting of Chislehurst.

Mr. Ferranti and Niagara Falls.—It is reported that Mr. Ferranti has secured a concession from the Canadian Government, which will enable him to utilise the Canadian portion of the Niagara Falls in the production of electrical energy.

Another Electric Railway to the City.—It is rumoured that the London and South-Western Railway Company intend to apply next session for powers to construct an electrical railway in a subway from Waterloo to the City. The general impression is that such a line would pay, and it is certainly wanted.

Electric Lighting at Sheffield.—The Parliamentary Powers Committee have recommended the Town Council to assent to the application of the Sheffield Telephone Exchange and Electric Light Company, Limited, for the supply of electricity in Sheffield, upon the terms of the draft provisional order submitted by them.

Government and the Telephones.—The *Times* of the 26th inst. contained a letter from "S" on the subject of "The Government and the Telephones," and the *Financial Times* of the same date a leading article, entitled "Telephones and the Government." Both draw attention to the desirability of Government purchase of the companies. The latter of our two contemporaries had yesterday an article on the "Possibilities of Post Office Telephones."

"Lightning."—In the "Glossary of Technical Terms (all rights reserved)" which appears in the new electrical journal, entitled "Lightning," appears the following brilliant definition. Non-conductor, insulator, di-electric="anything through which electricity cannot be forced in a *steady* stream." The necessity for "reserving all rights" is, of course, very apparent, as the temptation for contemporaries to copy would be otherwise irresistible.

Electric Launches Between Torquay and Paignton.—At a recent meeting of the Paignton Local Board, a letter was read from Mr. W. Robertson stating that he proposed to erect a charging station for electric motors of launches for service between Torquay and Paignton, and, as this could be erected to supply electric light to the town, he asked for the Board's views on the subject. The letter was referred to a committee of the whole Board.

Glasgow Merchants and the Telephone.—At the quarterly meeting of the Glasgow Chamber of Commerce, Mr. Seligmann drew attention to what he called the unsatisfactory working of the telephone system on the trunk lines. For a considerable time past, he said, the service had been giving great dissatisfaction as regarded the working to the larger towns such as Edinburgh and Leith, and individual subscribers could get little or no redress. Mr. J. L. Mitchell said that probably the fact of having called attention to the matter, the result would be that the telephone company would take the hint, and give better service in the future.

Electric Lighting in Wales.—The progress which electricity is making in Wales is indeed astonishing. One of the latest additions to the list of towns which have decided to adopt it in lieu of gas is Aberystwyth. The lighting of the town by electricity has for a long time been a much debated question, and many meetings of the town council have been held for the purpose of discussing the advisability of the step. At the ordinary meeting of the council last week, it was unanimously decided to hold a specially convened meeting of the whole council for the purpose of passing a resolution instructing the town clerk to apply for a provisional order to have the town lighted by electricity. Aberystwyth during the last few years has made great strides towards improvement, whilst its annual number of visitors have been more than doubled. With the advent of the electric light in the town it is anticipated that many of the hotels and boarding houses will also adopt it.

Electricity at Broken Hill.—An electric light and power company, it is stated, is getting to work at Broken Hill, Australia.

Overwinding in Mines.—Mr. W. H. Massey, in conjunction with Sir W. T. Lewis, has recently invented an automatic gear for the prevention of overwinding in mines.

Lighting of Artisans' Dwellings by Electricity.—It is proposed at Swansea to erect model artisan buildings, lighted by the electric light.

Dundee Mechanical Society.—Amongst other lectures to be given before this society during the coming winter session are the following :—December 17th, 1891, "Modern Telegraphy," with lantern illustrations, by W. H. Blakeney, A.I.E.E. March 25th, 1892, "The Telephone Exchange," by J. D. Miller, A.S.T.E. & E.

The Electric Light in the New Bankruptcy Courts.—The new and handsome pile of buildings intended for the Bankruptcy Court, and which are situated to the rear of the Law Courts, are now approaching completion. The buildings are being fitted throughout with the electric light, the contract having been secured by the Brush Company.

"The Irrepressible English."—There is perhaps not much disgrace in being considered irrepressible, and English electrical manufacturers ought to feel flattered by the following episode :—"The Vienna Communal Council was one evening last week the scene of a very heated discussion in regard to England and the English. The immediate cause was the application of a British firm for a concession for the erection of an electric light station in the suburb of Waehring. The Anti-Semitic members of the council strongly opposed the granting of the concession, and animadverted in no measured terms upon what they described as the unspeakable and irrepressible English nation. The Liberal majority as strongly defended the English, and the matter gave rise to quite a bitter dispute lasting several hours." As shown by the result, we are apparently not without friends even abroad.

The Electric Lighting of Glasgow.—The Committee of the Glasgow Town Council recently decided on Sir W. Thomson's recommendation to instruct Prof. A. B. W. Kennedy, F.R.S., London, to prepare a scheme of electric lighting on the low tension system. The committee intend having this low tension station erected on Blythswood Holm, so as to be able to supply electric light within a three-quarter mile circuit. Another of Sir William Thomson's recommendations likely to be acted upon by the committee is that Messrs. Muir, Mavor, and Coulson's present high tension station should be acquired by the Corporation to enable them to supply electric light outside the area that will be served by the low tension station, and we learn that on behalf of the Glasgow Corporation Electric Lighting Committee, Mr. Latimer Clark has been commissioned to act, along with Mr. James Muir, C.A., in making a valuation of Messrs. Muir, Mavor and Coulson's central lighting station.

Electrical Transmission of Power from Lauffen to Frankfort.—The *Scientific American* is evidently somewhat sceptical of the reality of this having been satisfactorily accomplished. The language in which this scepticism appears is rather funny, and is as follows :—"We are not told how the operators have overcome *the influence of that potent disturbance the Foucault currents*, which, from the time of Marcel Deprez's experiments at the railway shops of the Chemin de Fer du Nord in Paris down to the present time have rendered futile all attempts at the economical transmission of *large parcels of electricity* over a long line. One hundred miles is a long distance to transmit 300 H.P. less 25 per cent., and, if actually accomplished, it leaves a strong hope that both the load and distance may be gradually increased till finally the prophecy of Sir William Thomson, uttered at Niagara, will have been fulfilled, and vast quantities of power, gathered at the great falls, will be transmitted in the shape of electrical energy to operate mills and workshops and railways hundreds of miles away." If Foucault currents had been Marcel Deprez's only trouble, he would certainly have been more successful than he was.

Personal.—The last issue to hand of the New York *Electrical World* contains the portrait of Mr. C. E. L. Brown, whose connection with electric transmission of power over long distances by means of alternating currents is now so well known all over the world.

Heating by Electricity.—It is said that the first building in the world to be heated throughout by electricity is to be erected on lower Broadway, New York, U.S.A., to the designs of Messrs. Hale and Adams, of that city. The building, which will be 14 storeys high, will be lighted by means of 6,000 incandescent and 40 arc lamps.

At what Cost?—According to a New York correspondent, Mr. Edison asserts that by means of electricity as the motive power, the Pennsylvania's traffic between New York and Chicago could be conducted at any required speed by means of three stationary engines. During the Chicago Exhibition the inventor proposes to run trains by electricity between Milwaukee and Chicago.

Electric Light at Southampton.—EXTRAORDINARY TENDERS. At a meeting of the Southampton Pier and Harbour Board last week the engineer reported that he had examined the tenders sent in for the electric lighting fittings of the pier. They were fifteen in number and ranged in amount from £1,909 8s. 5d. to £575, the latter tender being accepted. It was stated that their agreement with the Electric Light Company was now sealed. The Sheriff expressed a hope that work would be pushed on. The report was adopted.

Society of Arts and the Chicago Exhibition, 1893.—A meeting of the Royal Commission was held at the Society of Arts, John Street, Adelphi, on Wednesday afternoon, 21st inst., to receive the report of Mr. James Dredge and Sir Henry Trueman Wood on the result of their visit to Chicago. The Attorney-General, M.P., was in the chair. The report was received, and ordered to be printed, thanks having been voted to the authors. They decided to appoint the following committees :—Finance, Fine Arts, Indian, Colonial, Engineering, General Manufactures, Electricity, Agriculture, Mines and Metallurgy, Textile Industries, Science and Education, Transportation; also a committee of ladies to correspond with the ladies' committee at Chicago. They further decided to invite the assistance of Chambers of Commerce as Local Committees. The prospectus of the Council of the Society of Arts, who have been authorised to act as Commissioners for this Universal Exhibition, has been issued. The Royal Commission are now prepared to receive applications for space, and to offer intending exhibitors all available facilities which they may desire. Such applications must be made upon forms to be obtained from the Secretary of the Commission, at their offices, Society of Arts, John Street, Adelphi, London, W.C.; these forms are to be sent in, filled up, not later than February 29th, 1892.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Law's Electrical Appliances Company, Limited.—An agreement of the 16th inst. (filed 20th inst.), with Major E. F. Law and Messrs. C. T. D. Crews, S. Macleay, J. T. Otway, W. J. James, and E. F. Law, decides that in consideration of certain patents relating to the use of electricity in connection with type-setting, 720 shares are to be allotted to the above-mentioned persons. These shares are fully paid up £5 shares. An agreement of the 17th inst. (filed on the 20th inst. also), with Messrs. William Clowes and Sons, Limited, has also been filed.

Norwich Electricity Company, Limited.—The annual return of this company, made up to the 10th inst., was filed on the 22nd inst. The nominal capital is £50,000 in £10 shares. Seven shares are taken up, but nothing has been called or paid thereon. Office, Old Bank of England Chambers, Queen Street, Norwich.

City of London Electric Lighting (Pioneer) Company, Limited.—At an extraordinary general meeting of the above-named company, duly convened and held at Winchester House, Old Broad Street, E.C., the following special resolution was unanimously passed and subsequently confirmed at a meeting held on October 20th, 1891. "That the company be wound up voluntarily." The following special resolution was also unanimously passed at the last-named meeting, "That the Hon. Alan Charteris and Mr. J. C. Bull be, and are hereby appointed liquidators for the purposes of such winding up, at a remuneration of fifty guineas each." (Filed on the 22nd inst.) Office, 1 and 2, Great Winchester Street, E.C.

Electric Arms and Ammunition Syndicate, Limited. The annual return of this company, made up to the 23rd inst., was filed on the following day. The nominal capital is £40,000, in £100 shares, 290 of which have been taken up and 210 considered as fully paid. The remaining 80 shares have had £70 per share called up, these resulting in a a payment of £4,860, leaving £740 unpaid. Office, 35, Queen Victoria Street, E.C.

Electric Traction Company, Limited.—A meeting of the above-named company was held on September 30th, 1891, at which an account showing the manner in which the winding up of the company had been conducted and the property of the company disposed of, was laid before the members. Filed on the 24th inst. Office, 35, New Broad Street, E.C.

BUSINESS NOTICES, &c.

Electric Lighting at Glasgow.—The new works which have recently been erected by Messrs. Arthur and Company, of Glasgow, at William Street, Anderston, have been lighted throughout by electric light, the whole of the electrical work having been carried out by Messrs. Ernest Scott and Mountain, Limited, electrical and general engineers, Close Works, Newcastle-on-Tyne, under the superintendence and to the specification of Mr. W. A. Bryson, consulting electrical engineer, Glasgow. The present plant consists of two Tyne compound-wound dynamos, each machine being capable of giving an output of 25,200 watts when running at a speed of 670 revs. per minute, and therefore easily capable of feeding 400 16-C.P. incandescent lamps each, but in case of emergency, either dynamo is capable of running up to a maximum of 600 lights each. The current from the dynamo is taken to a very massive switchboard, consisting of two large enamelled slate bases placed one above the other. On the lower slate base two coupling switches are placed, arranged so that the dynamos can be coupled in parallel or run singly if required. Two ampèremeters are also provided for measuring the current flowing from each machine, and two voltmeters of the Cardew pattern for reading the pressure. On the upper enamelled slate base five double pole main switches are fixed together with five automatic cut-outs. These switches control the five floors of the building by separate circuits, so that any floor can be switched off from the dynamo room. There are altogether 600 16-C.P. incandescent lamps, these are suspended from the ceiling throughout by flexible pendants, each pendant being fitted with a china ceiling rose, containing a fusible cut-out and a 10-inch enamelled iron shade.

Typewriting and Shorthand.—On Monday next, November 2nd, an exhibition of the Yost typewriter will be given at Exeter Hall at 7.30 p.m., and at 8.15 Mr. Oliver McEwan will deliver a lecture on Pitman's shorthand (with 40 entirely new and novel limelight views), during which he will give an illustration of his marvellous familiarity with the stenographic art by reading several portions of phonography, thrown upside down on to the screen, which he will not see until confronted with them. Mr. Newnes, M.P., Mr. I. Pitman and other gentlemen are responsible for the selection and preparation of the shorthand to be thus read.

Improvements in the Waterhouse Arc Lamp.—We learn that Mr. George Waterhouse, the inventor of the Waterhouse arc lighting system, has made considerable improvements in the construction of "the Waterhouse arc lamp," which will greatly tend to reduce the cost of manufacture, and that as soon as the patents have been secured for these new improvements this well known American system will be introduced into Europe, and worked in combination with the Waterhouse three-brush system of series regulation.

Brown, Boveri and Company.—Mr. C. E. L. Brown, late of the Oerlikon Works, is now in partnership with M. W. Boveri, in Baden, Switzerland. The firm is specially occupied in the construction of alternating and continuous current dynamos, and all things connected with electric lighting, transmission of power, traction, &c.

The Electric Light at the Crystal Palace.—Messrs. J. E. H. Gordon & Co., Limited, 11, Pall Mall, S.W., are laying the Archer patent jointed stoneware pipes, as underground conduits for their cables, in connection with the new works for the electric lighting of the Palace.

Ernest Scott and Mountain.—We understand that Messrs. Ernest Scott and Mountain, Limited, are extremely busy at the present time in their electrical department, and have in hand the lighting of Messrs. Jones Bros. & Co.'s weaving sheds at the Bedford Leigh New Mills, Bedford Leigh, near Manchester. This installation is precisely the same size as the one recently supplied to Messrs. Arthur & Co., at Glasgow. They have in progress the lighting of the Fustian Machine Cutting Company's new mill in Manchester, where they are supplying two dynamos, each capable of running up to 1,000 16-C.P. lamps. They are also lighting the Bolton Technical School, H.M.S. *Retribution*, Messrs. Hood, Haggie and Sons' works at Willington-on-Tyne, and have just made a contract for the lighting of a large training establishment at Newmarket for Lord Ellesmere.

International Electric Company.—This company (sole depôt of Messrs. Mix and Genest) has just issued a new illustrated catalogue of electric bells, indicators and accessories, microphones, telephones, telegraph instruments, electro-medical apparatus, and other things. The list is beautifully printed and the woodcut illustrations are well executed. Electro-medical apparatus is a prominent feature of the book, many standard patterns being enumerated, while a note states that the company is prepared to make any description of apparatus to special requirements.

Electrical Name Plate and Indicator.—We are not surprised that a paragraph which appeared in our notes column last week has suggested to Mr. N. G. Thompson, of 13, Victoria Street, to point out to us that he invented an identical apparatus, and patented it in 1885. If we remember rightly, one of Mr. Thompson's indicators was fixed, at least five years ago, at the entrance to the offices of Messrs. Crompton and Co., Mansion House Buildings, and we understand they are now in general use.

Electric Stores, Limited.—The Electric Stores, Limited, of 51, Cannon Street, have opened a show room at 10, Bow Lane, E.C. (opposite Mansion House Station), for the purpose of exhibiting samples of electrical fittings and other goods connected with the trade. In addition to their own specialities, they also stock goods of other well-known manufacturers, of which they are preparing a catalogue.

The Electric Lighting Company, Limited.—A general meeting of the above-named company is announced to be held at the office of the liquidator, Robert A. McLean, 1, Queen Victoria Street, London, E.C., on November 26th, 1891, to receive the liquidator's report and account, and fix his remuneration.

The Manganese Trade.—Mr. G. G. Blackwell, of Liverpool, the largest importer and manufacturer of manganese and other battery chemicals, has appointed as his agents in London Messrs. Stobbs, Wilson, and Pollard, of No. 4, Billiter Buildings, and has arranged for them to hold stock of his special goods.

Plymouth Lunatic Asylum.—Messrs. W. J. Corse and Co., electrical engineers, of 17A, Old Town Street, Plymouth, have secured the tender for the installation of the electric light throughout the new Plymouth Borough Lunatic Asylum at Blackadown.

Messrs. David Young and John T. Knowles have left Messrs. Haseltine, Lake & Co., patent agents, and commenced business on their own account, at 11 and 12, Southampton Buildings, London, W.C.

Andrews & Preece, Limited.—This company has puchased the business of Messrs. C. Wray & Co., of 3, Albion Court, Bradford, Mr. Cecil Wray accepting an appointment in the company.

Tender Accepted.—The electric lighting of the offices of the Sheffield *Daily Telegraph* has been entrusted to Mr. Wilson Hartnell, of Leeds.

CITY NOTES.

The Crompton Electric Supply Company of Australia, Limited.

THE following is an abstract of the directors' report presented to the shareholders at a general meeting held on Tuesday last:—

The directors have now received from Sydney the certified statements of account made up to May 31st, 1891, but they regret to state that the auditors report certain items in the Sydney accounts as being insufficiently detailed, and, therefore, they are unable to ask the shareholders to pass the accounts herewith as final.

Since the last meeting of the shareholders, Mr. J. F. Albright has visited Sydney and other parts of Australia, where he examined thoroughly into the business, and made an exhaustive and satisfactory report thereon, expressing himself hopeful as to future increase.

The Sydney committee have, with the accounts, sent home a report which is couched throughout in a sanguine and confident tone as to the position and prospects of the company.

Both of these reports can be seen upon application to the secretary.

A powerful syndicate has been formed in Sydney for the purpose of promoting a Bill in Parliament for the electric lighting of the City of Sydney. This company hold shares in the syndicate, and by the latest advices there is considerable hope of the Bill being carried.

Should the Bill pass this company will materially benefit, both as engineers and contractors, besides adding greatly to its credit and influence.

Messrs. Crompton and Company, Limited, have recently granted to this company, without payment for goodwill, the exclusive right to carry out electric work in New Zealand under their patents. Business has already resulted therefrom, and the prospects of future work are good.

The net profits available for division, according to the accounts, after making full provision for bad and doubtful debts, and deducting the dividend paid in October last year, amount to £1,558 3s. 6d.

The directors propose to distribute a further dividend of 2 per cent. for the year ending May 31st, 1890, making, with the interim dividend already paid, a total of 8 per cent. for that year, and an interim dividend of 7 per cent. per annum for the second year to May 31st last, carrying the balance forward, pending the receipt of the details from Sydney required by the auditors.

The company have forwarded to us the following particulars:—

The annual ordinary general meeting of the shareholders of this company was held at the registered offices of the company, Mansion House Buildings, Queen Victoria Street, E.C., on Tuesday, the 27th inst., J. F. Albright, Esq., in the chair.

The SECRETARY (Mr. F. R. Reeves) having read the notice convening the meeting,

The CHAIRMAN congratulated the shareholders upon the improved position of the company, as shown by the accounts before the meeting, which accounts he regretted, however, the directors were not able to ask the shareholders to pass as final, because information on some small matters of detail required by the London auditor had not yet been received from Sydney, he (the Chairman) had, however, no doubt as to the accuracy of the accounts, which were signed by the whole of the Sydney directors, and certified by an independent firm of public accountants in Sydney. Adverting to the promotion by the company of a Bill in the New South Wales Parliament for powers to supply electricity in the City of Sydney, the Chairman stated that the Bill had already passed the committee, and it was hoped they would be able to carry the Bill through, as if this were accomplished the financial results to the Australian Company were expected to be very large indeed, to say nothing of the important additional influence which the carrying out of such a scheme would bring to the company. He concluded by moving that the directors' report and statement of accounts be received, and that the report of the directors be adopted.

Mr. T. R. TUFNELL seconded the chairman's resolution, but spoke at some length, expressing his regret at the Sydney committee not having supplied the whole of the information required by the London board and directors.

The resolution was put to the meeting and carried unanimously, as was also a resolution declaring additional dividends of 2 per cent. for 1890, making 8 per cent. in all for that year, and an interim dividend of 7 per cent. for 1891.

The retiring director, Mr. W. G. Whiffen, was unanimously re-elected, and a resolution voting 50 guineas per annum each to the directors for their services, the maximum sum which the directors would agree to accept, notwithstanding a proposal to vote a larger figure, was also passed.

The auditors, Messrs. Payne and Banks, were re-elected, and the meeting closed with the usual vote of thanks to the chairman and secretary.

The Montevideo Telephone Company, Limited.

THE directors' report for the year ending July 31st last states that the accounts, including the balance of £184 1s. 6d. brought forward from last year, show a profit of £4,970 6s. 11d., after providing for all working expenses in Montevideo and London, and after writing off £114 14s. 8d. for proportion of preliminary expenses, and £20 for depreciation of furniture at head office and in Montevideo.

Taking into consideration the present position of business in Montevideo, consequent upon the severe commercial and financial depression that has existed there since July, 1890, and having in view the difficulty of collecting the amounts due by subscribers, and also regarding the amount which has been expended on capital account through the necessity for new lines and connections, the directors, being influenced by a desire to strengthen the position of the company, feel that the only course open to them is to recommend that the sum of £4,500, as advised by the auditors, be added to the depreciation fund, and the balance of £470 6s. 11d. be carried forward to next year.

In view of the almost complete collapse of commerce in the River Plate during the year now completed, the directors feel that there is cause for congratulation in the present position of the company, the manager of which has had several difficulties to contend with during the period now referred to. Through the stoppage of the National Bank at Montevideo, at a time when this company held a large amount of its notes, a considerable loss was entailed. As might be expected, the loss in bad debts through failures consequent upon the position of business generally, has been considerable, and the sum of £1,512 8s. 7d. has been written off to meet this. A further loss was occasioned by the defalcation of one of the company's collectors. Some unexpected expense has also been incurred by reason of new regulations issued by the Municipality of Montevideo enforcing the removal of supports and posts from the streets.

The number of subscribers has, naturally, fallen off to some extent, but there are still about 1,400 paying subscribers on the list, which is a position the directors have every confidence in maintaining, and eventually strengthening on any improvement in the general condition of affairs at Montevideo.

Arrangements for the reduction of the expenses, both in Montevideo and in London, have been made.

As provided for by the articles of association, Mr. Holland retires from the board, but, being eligible, offers himself for re-election.

The auditors, Messrs. Gérard van de Linde and Son, also retire, but offer themselves for re-election.

Babcock and Wilcox, Limited.

THE first general meeting of the shareholders of Messrs. Babcock and Wilcox, Limited, was held on Tuesday last at Cannon Street Hotel. Mr. Andrew Stewart, the chairman, presided.

The CHAIRMAN said that the meeting was merely of a formal character, it being a statutory obligation that the directors should call the shareholders together within four months of the formation of the company, but that no business beyond making a short report could be taken up. He said, however, that it might be interesting that a few facts in connection with the company and its formation should be expressed on this occasion. The allotment of the shares, which took place on July 7th, was of a very satisfactory kind, and the applicants were composed of the agents and officials and servants of the old company—who were supposed to know something of the merits of this patent boiler—also of the friends and connections of the old directorate, and, still more satisfactory, of many of those gentlemen who had been using the boilers, and therefore knew something of their merits and of the company as a sound and good investment. The principal proportion of the calls on the shares due on August 20th and October 1st were paid up in advance in the middle of September. He regretted that the Stock Exchange quotation had not yet been obtained, but this matter could not be forced, and he hoped all the technical requirements of the Stock Exchange would be completed within a very short time, when a quotation would be given on the Exchange. The certificates will be issued to the shareholders this week. He reported that as far as the directors have seen of the company's business, and the value of its productions, they were able to say, with confidence, that it exceeded their most sanguine expectations; also that they were very full of work, and were gradually extending their operations in new fields at home and abroad. In conclusion he reported that on the next occasion when they would have the pleasure of meeting the shareholders, he would certainly be able to give tangible proof that the board have laboured to some purpose.

Crompton & Co., Limited.—Owing to the continued growth of this company's business, it has been found necessary to obtain additional working capital, and the directors propose increasing the number of preference shares by issuing 10,000 additional shares of £5 each. 5,000 shares are to be offered first to the present members of the company at par; but the directors contemplate reserving the second 5,000 shares for a later issue, at a premium. An extraordinary meeting is to be held on 3rd prox. to pass the necessary resolution.

The Western and Brazilian Telegraph Company, Limited.—At a meeting of the board, held last week, it was decided that, after placing £25,000 to the reserve fund and £6,233 10s. to the debenture redemption fund, the directors would recommend, at the forthcoming meeting, a dividend of 6s. per share, free of income tax, or at the rate of £4 per cent. per annum for the six months ended June 30th last, being the same as for the corresponding period.

West India and Panama Telegraph Company, Limited.—For the half-year ended June 30th last, the directors propose dividends at the full rates on the first and second preference shares, with a distribution of 1s. per share on the ordinary. The sum of £2,000 is to be placed to reserve, leaving £5,255 to be carried forward.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend on the capital paid up on the ordinary shares, at the rate of 20 per cent. per annum, for the six months ending November 30th, 1891, payable on and after that date.

The Indo-European Telegraph Company, Limited.—The board of directors of this company, on 26th inst., declared an interim dividend for the half-year ended June 30th last, at the rate of 5 per cent. per annum, free of income tax, payable on and after November 1st next.

The Consolidated Telephone Construction and Maintenance Company, Limited.—This company announce a half-yearly interim dividend at the rate of 5 per cent. per annum, payable on November 16th.

European Sims-Edison Electrical Torpedo Company, Limited.—Letters of allotment of the European Sims-Edison Electrical Torpedo Company, Limited, have been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. Traffic receipts for last wee amounted to £756.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 23rd, 1891, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Company were £3,708.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Oct. 22nd.)	Closing Quotation. (Oct. 29th.)	Business done during week ending (Oct. 29th, 1891.)	
					Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	100 —103	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	48½— 49½xd	48 — 49	49½	48¼
2,849,510*l*	Do. do. 6 p. c. Preferred	Stock	87 — 88 xd	87 — 88	87¾	87⅛
2,849,510*l*	Do. do. Deferred	Stock	12¾— 13¼	12¾— 13¼	13	...
130,000	Brazilian Submarine Telegraph, Limited	10	11¾— 12¼	11¼— 11¾	12	11¼
53,200*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906	100	103 —107	103 —107	...	...
77,978*l*	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3¼— 3½	3¼— 3½	3$\frac{7}{16}$	3¼
69,996*l*	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2 — 2¼	2 — 2¼	2$\frac{3}{16}$	2
50,000	City and South London Railway, Nos. 1 to 50,000	10	2 — 4	2 — 4	3¼	...
$7,716,000	Commercial Cable, Capital Stock	$100	125 —130	140 —142	139	132
224,850	Consolidated Telephone Construction and Maintenance, Limited	14/-	$\frac{7}{16}$— $\frac{9}{16}$	$\frac{7}{16}$— $\frac{9}{16}$xd	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Preference Shares, Nos. 1 to 20,000	Stock	5 — 5½	5 — 5½	5⅜	...
16,000	Cuba Telegraph, Limited	10	10 — 11	10 — 11	10⅝	10½
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18	...	...
12,931	Direct Spanish Telegraph, Limited, (£4 only paid)	5	3½— 4	3½— 4	3½	...
6,000	Do. do. 10 p. c. Preference	5	9½— 10½	9½— 10½	...	...
60,710	Direct United States Cable, Limited, 1877	20	10⅞— 11⅛xd	10⅞— 11⅛	11	10⅞
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14¼— 14½xd	14¼— 14½	14$\frac{7}{16}$	14$\frac{1}{16}$
70,000	Do. 6 p. c. Preference	10	15 — 15½xd	15 — 15½	15$\frac{7}{16}$	15⅛
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	108	107½
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	108 — 111xd	106 — 109xd	...	...
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	15⅛— 15⅜xd	15⅛— 15⅜	15⅜	15⅛
78,300*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	104 —107	104 —107	104	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400	100	104 —107	104 —107	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	106 —109	106 —109	108¼	...
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	102 —105	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	99 —102	100½	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6¾— 7¼	6½— 7	6$\frac{15}{16}$	6$\frac{11}{16}$
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅝— 2⅞	2½— 2¾	3$\frac{1}{16}$	2¾
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000	2	3½— 3¾	3⅛— 3⅜	3¾	3¼
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd,	2	1¾— 2	1½— 1¾	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅝— 9⅞xd	9¾— 10	9$\frac{15}{16}$	9⅝
180,042	Do. do. 6 p. c. Preference	10	14¾— 15 xd	14¾— 15	15	...
150,000	Great Northern Tel. Company of Copenhagen	10	18¾— 19¼	18¾— 19¼	19	18⅞
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883)	100	105 —108	105 —108	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000	10	8 — 8½	8 — 8½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½— 10½	9½— 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited	10	20 — 21	20 — 21	20½	20¼
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43xd	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	6 — 7	6 — 7	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000	10	8¾— 9¼xd	8¾— 9¼	...	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6½— 7½	6½— 7½	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
43,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	9¾— 10¼	9¾— 10¼	10¼	10
447,234*l*	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 4⅝	4⅜— 4⅝	4⅝	...
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½— 13	12½— 13	13	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 13	12 — 13	12$\frac{7}{16}$	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid	...	105 —107	106 —108	107¼	106⅞
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid	10	5½— 6½	6 — 7	6¼	6$\frac{1}{16}$
220,000*l*	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	$\frac{3}{16}$ — $\frac{5}{16}$	$\frac{3}{16}$— $\frac{5}{16}$	...	...
9,000*l*	Reuter's Limited	8	8 — 8½	8 — 8½	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8 — 8½	8 — 8½	8$\frac{7}{16}$	8¼
7,900	Do. do. do. 7 per cent. pref.	2	7 — 7½	7¼— 7¾	7½	7$\frac{5}{16}$
3,381	Submarine Cables Trust	Cert.	117 —122	118 —123	...	...
78,949	Swan United Electric Light, Limited ... (£3½ only paid)	5	5 — 5½	5 — 5½	5¼	5
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	44	43½
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1894	100	102 —105	102 —105	...	...
58,000	United River Plate Telephone, Limited	5	2 — 3	1 — 2	1½	...
146,370*l*	Do. do. 5 p. c. Debenture Stock	Stock	85 — 95	85 — 95	...	...
3,200*l*	Do. do. 7 p. c. Debs., Nos. 1 to 1,000	100	... ...	... ...	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7½— 8½	7½— 8½	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	98 —110	98 — 101	...	...
30,000	West Coast of America Telegraph, Limited	10	3½— 4	3½— 4	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902	100	98 — 103	98 —103	...	...
67,007*l*	Western and Brazilian Telegraph, Limited	15	10¾— 11¼	10¾— 11¼	11⅛	11
30,364*l*	Do. do. do. 5 p. c. Cum. Preferred	7½	6½— 7	6½— 7	7$\frac{1}{16}$	...
30,364*l*	Do. do. do. 5 p. c. Deferred	7½	4¼— 4¾	4¼— 4¾	4¾	4½
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910	100	103 —106	103 —106	...	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1 — 1¼	1½— 1¾	2	1¼
34,563	Do. do. do. 6 p. c. 1st Preference	10	8½— 9	8¾— 9¼	9⅛	9
4,669	Do. do. do. 6 p. c. 2nd Preference	10	7 — 8	7½— 8½	...	...
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
42,853	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953	5	5¾— 6	5⅞— 6⅛	6$\frac{1}{16}$	5$\frac{15}{16}$

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7¼—7⅜.—City of London Electric Lighting (Pioneer), Shares of £50, fully paid, 60—62.—Ordinary of £10 each, £4 paid, 4⅛—4⅜.—Electric and General Investment, Shares of £5, £1 paid, 1¾—2¼.—Elmore's Austrian Copper Depositing, 15s., 25s., £2 share issued at 10s. prem. fully paid, 1—1¼.—Elmore's Priorities, 3⅞—4⅛.—House to House Company (£5 paid) 4½—5.—Liverpool Electric Supply, Shares of £5, £3 paid, 3⅞—4⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 1⅞—2⅛.—Manchester, Edison and Swan Company, £9 (£1 paid), ½ — ⅝.—National Telephone Debentures, 2½ — 3 prem. —Woodhouse and Rawson Ordinary of £5 (£2 10s. paid), 2⅛—2⅜.—£5 Preference, fully paid 3¾—4.—Debentures 90—95.—Wards Electric Car, £10 paid, ¾—1.

BANK RATE OF DISCOUNT.—4 per cent. (October 29th, 1891).

CONSIDERATIONS GOVERNING THE CHOICE OF A DYNAMO.*

By Prof. E. P. ROBERTS.

To select a dynamo for a given purpose is quite a different affair from designing one. In the latter case the type of machine is first determined, and the proportions of the electrical details decided by deduction from theory and experiment. The proportioning of the mechanical parts must be kept in view while designing the electrical features, and both mechanical and electrical elements varied until they unite to best subserve the attainment of the object desired, which is the construction of a dynamo to do the work required with the minimum of first cost, and with reliability and economy of operation. A dynamo designer should have, in addition to a knowledge of the laws governing electrical and magnetic circuits, a knowledge of machine design and construction. The knowledge so possessed must be applied to the study of the results following the modification of any feature in the general type and special form chosen. The study of the various losses taking place in a dynamo necessitates an analysis of the same, in order to obtain the value of each loss when the details of the general design are modified. Such losses are friction, ohmic resistance, self-induction, magnetic resistance, magnetic leakage, Foucault currents, hysteresis, &c. After obtaining the above information, the dynamo designer will apply his personality—which is partly genius, but mostly the result of varied experience carefully digested—and the result will be a piece of apparatus which will accomplish the object desired with as much certainty as will a special machine tool designed by an expert in that line.

The purchaser of a dynamo approaches the subject from a very different direction. He desires a dynamo which is, above all, reliable; secondly, efficient as regards the ratio of the power generated to that consumed; and thirdly, efficient in all the many ways which go to make any machine efficient in every-day use; fourthly (or firstly, secondly or thirdly, according to circumstances, but more generally according to the wisdom of the purchaser), cheap. In order to criticise a dynamo, it is advisable to analyse it and study each element. In order to do this systematically, the following chart is prepared, and then a few remarks made under each heading. The chart refers only to points to be studied by a purchaser. If a dynamo has 90 per cent. commercial efficiency under a certain load, he does not care what disposition is made of the 10 per cent. lost, provided it is not detrimental to the lasting qualities of the dynamo. It is all the same to him if 2 per cent. be lost in Foucault currents, and 3 per cent. in ohmic resistance, and 5 per cent. in friction, as it would be if the figures were interchanged, provided lubrication and insulation do not suffer.

Dynamo ...	Mechanical design ...	Strength, rigidity, accessibility, lubrication, revolutions per minute.
	Construction	Material, workmanship, balance, manufactured to gauge, insulation.
	Electrical design ...	Commercial efficiency, operative efficiency, adaptability to work desired, heating, sparking.

These points will be considered in the following order:—

1. Mechanical design.
2. Electrical design.
3. Construction.

These divisions can be advantageously subdivided, but the line of demarcation is not distinct, and remarks under one head will sometimes be repeated in part, or referred to, under other divisions.

1. Considering the dynamo as a mechanism, there present themselves as to its design:—(*a*) the frame; (*b*) the bearings; (*c*) the revolving portion.

(*a*) The frame should be rigid, should give ease of access to the commutator and brushes for adjustment and cleaning, and should allow repairs to be made with ease and celerity to such parts of the mechanism as are subjected to the greatest stresses, electrical or mechanical, or to constant wear. The frame should make the centre line of the revolving portion as low as practicable, and have a good spread of base.

(*b*) The bearings should be of ample size, easily replaced, and have positive lubrication. Also, arrangements for catching the oil after use should be provided; no oil should creep along the shaft, or be thrown off. Oil in any other place than the bearings is not only unsightly and liable to cause fires, but also collects dirt and copper dust from the commutator, causing electrical troubles. Upon the score of economy all oil should be caught and strained, and then either mixed with fresh oil and used in the dynamo, or used for shaft or other slow-speed bearings.

(*c*) The revolving portion should be firmly fastened to a rigid shaft, and should not depend merely upon set screws or other form of frictional fastening. The shaft should never bend; since if it does, even to a slight degree, increased friction at the bearings will result. Possibly, also, the revolving portion may hit the stationary parts, or the shaft may break after running a short time. The fewer the revolutions per minute the larger the pulley upon the dynamo, and this is important, particularly when the dynamo is driven from shafting, as large pulleys—especially large friction pulleys—are expensive and necessitate considerable space within which to rotate.

2. *Electrical Design.*

The main point to be considered, under the head of Electrical Design, by the purchaser of a dynamo, is its "commercial efficiency," which is the ratio of the power given out to that absorbed. The power given out is expressed in watts, and that absorbed in foot-pounds or horse-power. Another kind of commercial efficiency must, however, be considered.

First, the commercial efficiency in its limited sense as above used. Next the output per dollar expended, (*a*) in buying the dynamo, (*b*) in furnishing power, (*c*) in operating expenses of all kinds, and (*d*) in reliability. Combining these is obtained what is herein termed the "operative efficiency."

It is very evident that an unreliable dynamo is not practically efficient, however well it can be made to perform during testing.

It is, of course, desirable that the dynamo should have a large output per horse-power absorbed, that is, "commercial efficiency," not only when at full load, but under any fraction of the same. It is also desirable that it should have a large output:—

Per dollar of first cost.
Per dollar of repairs.
Per dollar of attendance while running.
Per dollar of attendance to clean.
Per pound of total weight.
Per square foot of floor space.
Per cubic foot space (in some locations, as on board ship).

The output per horse-power expended at the dynamo pulley to drive the same is a matter easily obtained, to a fair degree of accuracy, without expensive apparatus.

The horse-power absorbed can be measured by a number of devices. Numerous forms of transmission dynamometers are in use. An excellent one is the Van Winkle dynamometer. The pulley which transmits power to the dynamo is loose on the shaft and is rotated through the medium of spiral springs, one end of which is fastened to the pulley and the other end to a disc keyed to the shaft. Mechanism is arranged which indicates by a pointer the tension on the spring at any moment. The revolutions per minute being known, the horse-power can be computed. A scale is attached, and the horse-power transmitted can be directly read. Some prefer to have the figure indicated not to the actual amount, but one the value of which can be found by reference to a private note book. The apparatus is split throughout, so that it can readily be placed upon any shaft, and bushings can be inserted to fit the shaft.

The Brackett cradle is extensively used, and consists of a platform upon which the dynamo is placed, said platform being suspended by end frames carrying knife edges resting upon hardened surfaces. The dynamo shaft is adjusted until its axis passes through the line of the knife edges.

The dynamo is so balanced by weights carried on horizontal arms or on the bed of the cradle, that the latter swings easily and freely on the knife edges, and by means of weights vertically above or below the knife edges the centre of gravity is adjusted until any desired degree of sensitiveness is obtained, viz., until any desired change on the counterpoise or the horizontal arm throws the cradle out of balance. The centre of gravity must not be raised above the line of support or the cradle will be in unstable equilibrium, *i.e.*, will be top-heavy, and will remain tipped to either side. The belt must be off the pulley while adjusting the weight.

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* Paper in the *Journal of the American Association of Engineering Societies.*

When the dynamo is driven the reaction of the armature upon the field tends to rotate the system, and balance is maintained by adjusting the position of the counterpoise on the horizontal arm or by the extension of a spring scale balance attached to it. The continued product of the weight of the counterpoise (or pull on the spring balance), its horizontal distance from the centre line and the revolutions per minute of the dynamo, equals the foot pounds taken by the dynamo.

The number of revolutions per minute may be determined by any one of several devices. A common method is to use a watch and a speed indicator, the point of which is held against the centre of the shaft, and the speed is determined by noting the number of revolutions indicated on the dial during a minute or any convenient fraction thereof. This method is rather troublesome unless two observers are available, one to attend to the indicator and the other to call time. A convenient instrument combines the indicator with a stop watch in such a way that the rotating point operates the registering device only for a certain length of time, so that the revolutions per minute are indicated directly. Another class of instrument is the tachometer, which may either be operated by a belt or may be held against the end of the shaft. In the tachometer centrifugal force causes a pointer to move along a scale graduated to read revolutions per minute. The greatest source of inaccuracy in the use of any of these instruments is the liability to slip. This is minimised in the case of instruments operated by contact against the end of the shaft by having sharp edges on the point or giving it a soft rubber tip. A good method is to use a three-edged punch, and punch the "centre" with the same. The marks thus made hold the point of the counter, and do not injure the centre. In the use of the tachometer and belt, care should be taken that the belt is tight and that the pulley on the shaft is of the exact size required. When an indicator is not obtainable the speed may be determined approximately by counting the revolutions of engine or shaft and multiplying by the ratio between the diameters of pulleys. The speed of the engine may be counted by letting one hand move by some reciprocating part or allowing some part, such as a set screw, on the shaft or crankpin of the engine, to strike the hand at each revolution, while a watch is held in the free hand.

One make of engine, the Ide, has an indicator of horsepower being developed. It really shows the point of cut-off. The number of revolutions and initial pressure of steam being known, the horse-power is determined, and the scale calibrated accordingly. If the friction be deducted, the amount being obtained by friction cards, the horse-power transmitted to the dynamo is closely approximated.

(To be continued.)

OPENING OF THE DUSSELDORF CENTRAL STATION.

ON September 1st Messrs. Schuckert & Co., of Nuremberg (who are represented in England by Mr. Charles Müller, of Bradford), completed the Municipal Electricity Works in Düsseldorf, which they had carried out on behalf of the town council. Since that day the works have been in regular operation, but it was only on Saturday afternoon last (24th) that the inauguration took place. The Düsseldorf municipality now own the gas, water and electricity works, which are under the management of Herr Grohmann.

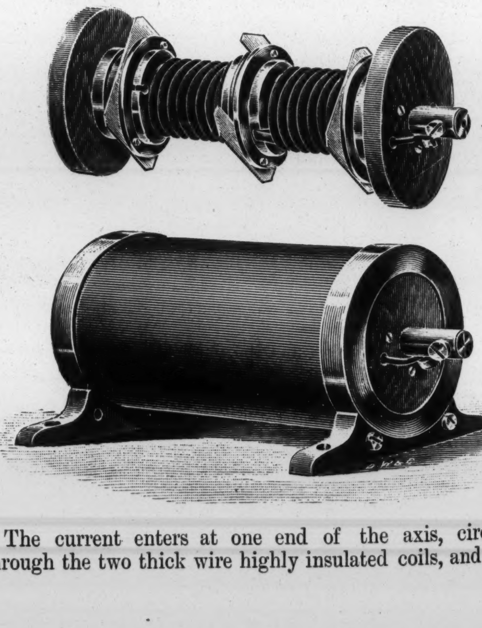
As at present arranged, there are one principal and three secondary stations, the central one being very close to the gas works. This method has been adopted so as to combine the two undertakings under one general management, and also to allow of a plentiful supply of coal to be at hand. The sub-stations are situated at a distance of about one and a-half miles from the central station, the first being in Bleichstrasse, the second in the Bade-Anstalt, and the third in Karlsstrasse. The current from the generating dynamos is used partly to charge the secondary batteries in the sub-stations, and partly to feed the distributing mains simultaneously with the accumulators. The latter receive the current which is in excess of temporary demand when the machines are running at normal load, and in the hours of minimum demand they alone suffice, whilst when the consumption of current is the greatest, both the batteries and the dynamos work in conjunction. By this means it is claimed that the dynamos run at regular load during all working hours.

The central station contains three water-tube boilers made by the Hohenzollern Company of Düsseldorf, one being as reserve; each has a heating surface of 150 square metres. The two steam engines, which will shortly be supplemented by a third, was supplied by the Saxon Engineering Works of Chemnitz; they are of the horizontal type with tandem cylinders, work at 120 lbs., and are of 300 normal H.P. Each engine is direct coupled to a Schuckert dynamo giving 1,000 ampères at 350 volts. In addition to the mains connecting the central with the sub-stations, and which were furnished by Messrs. Felten and Guilleaume, of Mülheim-on-the-Rhine, communication is possible by means of signals and telegraphic wires. Two of the sub-stations contain small batteries, whilst in the third, near the Tonhalle, two sets of 140 cells each, placed in parallel, and having a total output of 1,000 ampères, are arranged. These storage batteries were provided by the Accumulator Works Company, Limited, of Hagen, who have undertaken to maintain them for 10 years. A constant voltage of the current at the places of consumption is effected by the regulation of the batteries at the secondary stations.

The generating station has been equipped for the simultaneous supply of 10,000 incandescent lamps, and the distributing mains to carry current for 25,000 lamps. Ample space is available for the erection of both generating and storage plant. Applications equivalent to 15,000 16-C.P. lamps have already been received; and 171 installations, comprising 12,000 lamps, are either already put up or in process of installation.

LIGHTNING GUARD FOR ELECTRIC LIGHT INSTALLATIONS.

THE woodcut shows one of the latest forms of Dr. Lodge's lightning guards, as designed for the purpose of filtering lightning out of electric light leads, and as constructed by Messrs. Muirhead & Co., Cowley Street, Westminster.



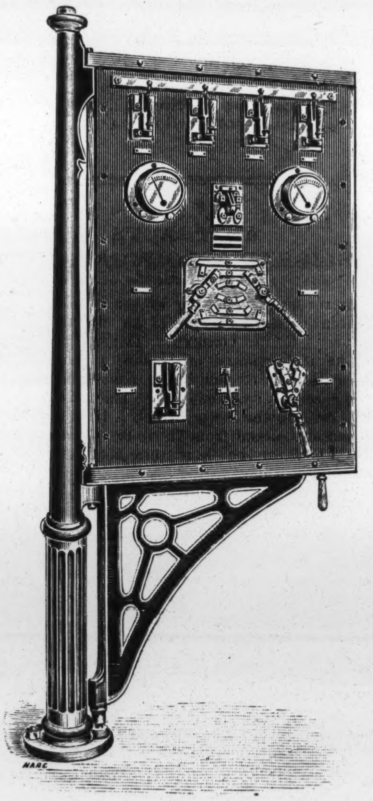
The current enters at one end of the axis, circulates through the two thick wire highly insulated coils, and leaves by the other end of the axis. But in so doing, it has passed three pairs of brass collars which clamp between them a square of mica coated with tinfoil, the corners of which come very close to an outer metal case connected with the ground. When lightning therefore attempts to follow the current, it spits off from one or other of the corners of the first tinfoil to earth, thereby striking a momentary arc, which is destroyed the next instant by the fusion of that corner of tinfoil. The other corners remain ready for a future occasion. We understand that by the kindness of Major Cardew and Mr. Wimshurst, one of these instruments has been privately tested at the Board of Trade laboratory, and has been found to work exactly as intended.

The air gap necessary between the brass collars and the outer case must depend on the voltage of the installation for which it is designed, and the length of arc accordingly to be expected. At present it has only been tested up to about 100 volts.

NEWTON AND HAWKINS'S SWINGING SWITCHBOARD.

Our illustration represents an arrangement of a switchboard whereby a great many of the difficulties which are always met with in erecting those of the ordinary type are obviated, much time is saved, and the annoyance and possible danger of a bad joint in an inaccessible position behind a heavy fixed switchboard rendered almost impossible.

Messrs. Newton and Hawkins make their switchboard with suitable hinges firmly attached to the board itself, these hinges being hung, either upon hangers finally secured to the wall or upon cast iron pedestal bolted to the floor.



The switchboard stands a little away from the wall and the cables leading to the various terminals on the switchboard are all assembled in the space formed between the switchboard and wall. The board can be unlocked and swung forward 90° or so, sufficient slack being left in the cables to permit of this; the cables and all connections are thus immediately brought into a convenient position for manipulation. All electrical engineers must have experienced the trouble, expense and delay occasioned by the erection of a heavy slate switchboard of the ordinary construction, which is entirely obviated by this invention.

The pedestal or hangers can be fixed and the wires all laid and labelled and brought to suitable positions in the space behind the board, which can then be placed on its hangers and thus supported in the most convenient manner whilst it is being connected up. When this is done, the board is swung into position, locked or bolted, as the case may be, and all is complete.

It is found in practice that the saving of time and labour quite compensates for the slight extra cost of making the board in this manner.

REVIEWS.

Economics of Iron and Steel. By H. J. Skelton. Biggs and Co., 139 and 140, Salisbury Court, Fleet Street, E.C.

This book is written by a writer who has had large practical experience in the subject with which he deals. Of large treatises on iron and steel there are a few in existence, but they are generally so overloaded with unpractical matter that their value is much diminished by the same. Smaller treatises also exist, but in most cases they are hardly up to date, and consequently are unsatisfactory, though there are exceptions. The work before us certainly belongs to the latter class, and can be highly recommended. The 18 chapters into which the book is divided are as follows:—Chapter I., "Ironstone and Iron Ore;" Chapter II., "Pig Irons;" Chapter III., "Pig Iron Warrants;" Chapter IV., "Iron Castings;" Chapter V., "On Testing Cast Iron;" Chapter VI., "Puddled Iron;" Chapter VII., "Staffordshire and other Irons;" Chapter VIII., "Sheet and Plate Iron;" Chapter IX., "Scrap and other Qualities of Iron;" Chapter X., "Galvanised Sheet Iron;" Chapter XI., "On Testing Wrought Iron and the Tests for the Same"; Chapter XII., "On Testing Wrought Iron in the Smithy;" Chapter XIII., "Steel;" Chapter XIV., "On the Tests Applied to Ascertain the Quality of Steel;" Chapter XV., "Tin Plates;" Chapter XVI., "Quarterly Meetings of the Iron Trade;" Chapter XVII., "General Considerations Affecting the Purchase of Iron and Steel;" Chapter XVIII., "Sizes and Sections of Rolled Iron and Steel." It will thus be seen that the whole ground is fairly covered, much matter of practical interest being included. The series of tables in the last chapter is especially useful, though it shows (as the author states) that there is a needless and wasteful elaboration of variety in sections which might with advantage be brought down to a greater uniformity of requirement. The following is interesting:—Referring to "Qualities of Sheet Iron," the first classification is "Common Quality," *suitable for the Indian markets.* This iron is branded "best refined," and, says the writer, is "usually the most unrefined adulterated rubbish in the shape of iron that will cohere." The book, though not a complete treatise on the subject, compares very favourably with others of a more elaborate nature.

The Electro-magnet and Electro-magnetic Mechanism. By Silvanus P. Thompson. London: E. and F. N. Spon, 125, Strand.

This work, which is one of the "Finsbury Technical Manuals," is an amplification of the Cantor lectures delivered by the author in 1890, before the Society of Arts.

The book, like others written by the author, shows a wonderful amount of research, and it should prove a very valuable reference work. Large, however, as is the field covered, a great deal more might be said with reference to "electro-magnetic mechanism," though no doubt it would be difficult to know where to draw the line, and probably Dr. Thompson has done wisely in curtailing the subject in the manner he has done. There is very much yet to be learnt with reference to the action of electro-magnets, especially as regards their use for telegraphic purposes; the getting rid of residual magnetism has been a problem which has never been satisfactorily solved. Those, however, who wish to fairly study the subject can get an excellent preparation by carefully reading Dr. Thompson's book.

THE FUTURE OF THE ELECTRIC RAILWAY.

Mr. Frank Sprague, in the September number of the *Forum*, predicts that electricity, as a motor, is going to carry all before it. His account of the electric railways in America is very remarkable, especially as to the safety with which they have been operated.

The first electric railway was opened in Richmond in 1888; now there are not less than 350 roads in the United States, Europe, Australia, and Japan, requiring more than 4,000 cars and 7,000 motors, with about 2,600 miles of track, a daily mileage of nearly 500,000 miles, and carrying nearly a billion passengers annually. Fully 10,000 people are employed on these roads, and there has never been an authenticated report of death on account of the electric pressure used.

Over ten million sterling is now invested in this industry, and overhead wires are accepted as the best method of applying the current.

While the horse, with extra help, has slowly and painfully pulled his car up a 5 per cent. grade, the electric motor has propelled a car of double the weight up grades of from 10 per cent. to 13 per cent., and at nearly double the speed. It has conquered combined curves and grades impossible for even the cable, and has increased the schedule speed with perfect safety from 50 per cent. to 100 per cent.

Larger and more luxurious cars have been made possible, and the available carrying capacity for a given street space occupied has been increased by one-half. Malodorous stables have disappeared, and streets have been made cleaner.

The action of the motor as a dynamo is utilised to make the descent of the heaviest grades absolutely safe, even if the whole system exterior to the car should fail.

The abolishment of the car store is now possible, and on heavy grades the falling energy of the car is used through the motors not only to put a brake upon its own speed, but also to heat the car without taking energy from the central station, as on the Pleasant Valley road in Pittsburg.

The electric motor has halved the motor-power expenses per car-mile, and has effected even greater reduction in the cost per ton-mile. It has reduced the charge per car-mile for conductors and drivers by increasing the number of miles operated in a given time. Roads hitherto unproductive have become dividend earners, and the earnings of those already successful have been increased. Roads are now possible where horse, steam, or cable service was impossible. Years have, in the aggregate, been saved to men for rest and recreation.

For street railways, Mr. Sprague thinks that there is absolutely no doubt that electricity is the motor of the future. The speed at which the electric cars can be driven practically doubles the area in which people can live in comfort. The original article, of which the foregoing is an abstract, is well worth the attention of engineers.

NEW PATENTS—1891.

17,324. "Improved method of electric lighting in series and apparatus therefor." G. J. Parfitt and G. J. T. J. Parfitt. Dated October 12th.

17,399. "Improvements in dynamo-electric machines." E. T. Gilliland. Dated October 13th. (*Complete.*)

17,402. "Improvements in telephonic transmitters." A. Marr. Dated October 13th.

17,406. "Improvements in arc electric lamps." J. T. Todman and A. E. Angold. Dated October 13th. (*Complete.*)

17,426. "Generating ozone by electricity." E. Andreoli. Dated October 13th. (*Complete.*)

17,430. "Electric batteries." D. M. Lamb. Dated October 13th. (*Complete.*)

17,434. "Improvements relating to dynamo-electric machines." F. Bryan and Woodhouse and Rawson United, Limited. Dated October 13th.

17,454. "Improvements in electric conductors for the distribution of electric currents and in conduits therefor." R. Threlfall. Dated October 13th. (*Complete.*)

17,459. "Improvements in and relating to electric bells and indicators." G. H. Jones. Dated October 13th.

17,470. "Improvements in the holders of incandescent electric lamps." R. J. Bott. Dated October 13th.

17,581. "An anti-binding wire insulator for suspending or carrying electrical wires." F. J. Morgan and W. R. James. Dated October 15th.

17,614. "Improvements in couplings for electric wires." A. Shiels. Dated October 15th.

17,631. "Improvements in the process and apparatus for electrolytic manufacture of tubes, pans, and other bodies of circular form." A. S. Elmore. Dated October 15th.

17,652. "Improvements in carbons for electric arc lamps." H. H. Lake. (Communicated by The Thomson-Houston International Electric Company, United States.) Dated October 15th. (*Complete.*)

17,655. "Improvements relating to the heating of metals by electricity and to machines therefor." G. D. Burton, A. H. Eddy and G. T. Briggs. Dated October 15th. (*Complete.*)

17,706. "An improved form of voltmeter." F. H. Nalder, H. Nalder, C. W. S. Crawley and A. Soames. Dated October 16th.

17,707. "An improved form of voltmeter." F. H. Nalder, H. Nalder, C. W. S. Crawley and A Soames. Dated October 16th.

17,719. "An improved electric or galvanic battery and its adaptation to brushes and other articles." A. H. Byng. Dated October 16th.

17,725. "Improvements in battery compounds." A. P. Morison, J. Hirshfeld and W. Wright. Dated October 16th.

17,726. "Improvements in portable electric lamps and battery therefor." A. P. Morison, J. Hirshfeld and W. Wright. Dated October 16th.

17,731. "Improvements in electric motors." O. Linders. Dated October 16th. (*Complete.*)

17,732. "Improvements relating to electric motors." O. Linders. Dated October 16th. (*Complete.*)

17,733. "Improvements in electric machines for drilling, boring, grinding, and the like." O. Linders. Dated October 16th. (*Complete.*)

17,734. "Improvements in electric switches." O. Linders. Dated October 16th. (*Complete.*)

17,758. "Improvements in elements for secondary batteries." The Mining and General Electric Lamp Company, Limited, and J. T. Niblett. Dated October 17th.

17,808. "Improvements in electrical accumulators or storage batteries." A. J. Boult. (Communicated by H. L. H. Maugras, France.) Dated October 17th.

17,809. "Improvements in or applicable to magnetic compasses or other instruments in which dials or movable indices are employed." T. G. H. Nicholson. Dated October 17th.

17,818. "Improvements in or connected with electric transformers or induction apparatus." L. Pyke and E. S. Harris. Dated October 17th.

17,823. "An application of the electric light to a gun for the purpose of illuminating the object aimed at." C. W. L. Barber. Dated October 17th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

11,065. "Improvements relating to the impregnation of organic fibrous and cellular matter by means of an electric current, and apparatus therefor." G. A. Oncken. Dated July 15th. 8d. The substances to be impregnated are placed in boilers provided with electrodes, one at the end of each boiler, connected by suitable circuit wires and switches with a dynamo electric machine; the impregnating solution is pumped into the boiler, which is then heated by the steam heating pipe system to about from 75° to 93° C., and previous to its attaining this temperature the electric circuit closed.

12,832. "An electrical wattmeter, also applicable as an ammeter or voltmeter." E. Wilson. Dated August 15th. 8d. Instead of causing the combined action of an electro-motor and ammeter or electro-dynamometer to produce a registration upon a counter, as in a previous invention, the inventor arranges these parts in combination with a cylinder covered with paper and rotated by the motor actuated by the current, and with a pencil or style controlled by the ammeter or electro-dynamometer, so that the pencil or style is made to effect a permanent registration upon the paper of the cylinder by tracing a line that will represent the watts consumed. 3 claims.

14,404. "Improvements in electrical switches." C. S. Snell. Dated September 12th. 8d. Claims:—1. The construction or combination of the parts of a switch, whereby an intermediate lozenge, or its equivalent, is used to receive the impulse from the handle against the force of suitable springs, in such a manner that after a certain degree of rotation, the said lozenge being turned beyond the "dead centre" position, these springs in returning towards their normal position cause the lozenge to continue its motion, and, although the handle be held rigid, to carry the switch arm "on" or "off" contact, as may be desired, substantially as and for purposes herein described and illustrated in the drawings. 2. The construction of a switch in which a plate with lugs and pins forming a lozenge, or its equivalent, placed under the switch arm or brush, substantially as and for the purposes herein described and illustrated in the drawings.

14,411. "Improvements in secondary batteries." J. T. Niblett. Dated September 12th. 8d. Consists of one or more cells composed of leaden receptacles arranged on separate compartments of a case of wood or other suitable material. Within each leaden receptable is a porous pot of earthenware, or some such insulating porous material. The cubical contents of the space between the leaden receptacle and the porous pot is preferably about equal to the cubical contents of the pot; both spaces are filled in with spongy lead or active material, sometimes in conjunction with inert material. 7 claims.

14,696. "Improved telegraphic relay." J. P. BAYLY. (A communication from abroad by J. M. Treber, of America.) Dated September 17th. 8d. Claims:—1. In a relay, the combination, with a horizontal single magnet having the upwardly projecting poles, of a lever having its contact point at one end and a yoke at the other end, a horizontal single magnet carried by said yoke and having its poles adjacent to the poles of the first-mentioned magnet, a main circuit including the said magnets, and a plurality of local circuits operated by the contact end of the lever, substantially as described. 2. In a relay, the combination, with a stationary magnet, of an armature magnet carried at one end of a lever, a contact spring above the other end of the lever, a contact pin beyond the end of the lever and under the spring, a main circuit including the said magnets, a connection from a battery to the spring, and branch connections from the battery to the lever and to the contact pin, said branches including translating devices, whereby the vibrations of the armature lever will alternately operate two local circuits, substantially as described. 3. In a relay, a single magnet having its pole pieces in the form of two brackets, the feet of the brackets being secured to the base out of the vertical plane of the magnet, whereby the magnet may be located close to the base, and the said pole pieces serve the double function of influencing the armature and securing the same in position.

14,698. "Improvements in conductors for the distribution of electrical energy, and in apparatus connected therewith." R. E. B. CROMPTON and W. A. CHAMEN. Dated September 17th. 1s. 3d. Relates to single tubular insulators which may be of any desired form, the exterior being corrugated or provided with projections so as to increase the length of insulating surface, and hence decrease the surface leakage of the electric current, provided that the tubular opening through the centre of the support be of sufficient size to allow the copper strip or strips to pass through it. Also that the side walls of the tubular insulators will be of sufficient substance to sustain the required compressive strain brougbt on to it by the straining gear. These tubular insulators can be mounted in suitable recesses cut in the sides of single anchoring supports or beams pierced for the required number of conductors. The strain is transmitted from the strip to the tubular insulator by means of a suitably formed cap made of gun metal or other material. In order to prevent the chipping or crumbling away of the edges of the comparatively brittle metal that is usually used for such insulators, the inventors interpose at each end of the tubular insulator tubular washers made of felt, rubber, woodite, or other material of an elastic or semi-elastic nature, not liable to cause corrosive action or to decay. The copper strips are secured in the caps by pinching screws. One form of straining device consists of a separate or dummy clamp fixed to the strip by pinching screws at a convenient distance from the face of the tubular insulator. In this space intervening between the two an apparatus consisting of two concentric nuts each in halves, so as to be easily removed from the strip, is arranged so that by operating these nuts by suitable tools one end can be made to recede from the other, and so tend to force the dummy clamp further away from the insulator cap, and thus gradually draw the strip through the tube in the insulator. As soon as the screw has been extended to its full stroke the pinching screws in the insulator cap are tightened down and the screw is slacked back to the commencement of its stroke, and the dummy clamp is brought close to it and again pinched down on the strip, and the operation is repeated until the required degree of strain is brought on the strip, after which the pinching screws in the insulator cap are finally tightened down, and the apparatus removed. 13 claims.

14,830. "Improved means of accommodating electric wires in buildings." F. WALTON. Dated September 19th. 4d. The inventor forms of composition like that used for "l'incrusta" a moulding in two thicknesses, the one thickness having longitudinal grooves to receive the wires, and the other thickness being of any ornamental design to form a cover cemented over the wires. According to another method, he imbeds the wires in the material of the moulding when it is being made. 1 claim.

16,279. "Improvements in the process and apparatus for electrical casting of metals." N. SLAWIANOFF. Dated October 13th. 8d. Claims:—1. The process of casting metals or alloys, or altering their properties, by producing a regulated electric arc, one of the electrodes of which is a rod of metal to be melted, the other being the mould or the metal melted therein. 2. The modified process, wherein two electric arcs are employed, subject to differential regulators. 3. For conducting the process above referred to electric current regulators and apparatus constructed and arranged, substantially as described with reference to the drawings.

20,821. "Apparatus for transferring electric-car batteries." F. G. CORNING. (Under international convention.) Dated May 21st. 8d. Relates to devices for facilitating the transfer of "secondary batteries" or "accumulators" from an electro-motive car to the recharging shelves or benches, wherein a great extent of charging space is required to be condensed within a restricted horizontal limit, and wherein a saving of time in transferring the batteries and substituting recharged ones on the car for those exhausted becomes an important object. 9 claims.

20,936. "Improvements in electrical signalling apparatus, especially designed for signalling at sea." A. B. WYCKOFF. Dated December 23rd. 6d. Claims:—1. The combination of a dynamo or other generator of electricity, a lamp or group of lamps, a rotating shaft having projecting arms in different planes and segments, one for each of said arms, one segment serving to direct the current to the lamp or group of lamps, and the other segment shunting the current back to the dynamo, substantially as specified. 2. The combination of a dynamo or other generator of electricity, a lamp or group of lamps, a resistance, a rotating shaft having projecting arms in different planes, and contact segments, one for each arm, one of said segments being connected with the lamp or lamps, and the other with the resistance, the segments and arms being so arranged that contact is made by one arm with its segment simultaneously with the breaking of the contact between the other arm and its segment, substantially as specified.

CORRESPONDENCE.

Induction.

Will you or one of your readers kindly say where I can find the papers by Mr. Preece and Prof. Ayrton on induction, referred to by Messrs. Dresing and Gulstad on page 589 of your issue of 8th May last, and other information on the same subject?

The following case of induction may interest some of your readers.

The cable from here to Singapore is landed eleven knots north of the office to which it is connected by one of three cores laid in 2 inch iron gas pipes. For about 10 miles these pipes run at the foot of the poles carrying the Government wire.

If we earth the cable from Singapore at or near the office, we always get a shake on the line when receiving from Singapore if the Government office is sending. In wet weather it is even often bad enough to render the signals unreadable.

That the disturbance is not caused by bad earth is proved by the fact that earthing on the outside wires of the cables to Australia, half a knot away, does no good, and that the signals on the latter cables, which run south east from the office, are never affected although worked on the same instrument and earth.

It is evidently caused by the leakage from the Government line returning along the iron pipe and inducing currents on the cores inside.

Earthing the cable at the cable house by a second core is, of course, a perfect remedy.

C. H. Pownall.

Banjoewangie Station,
Sept. 7th, 1891.

Telephoning of Great Cities.

I find that Mr. Miller has written a second letter, in which, after apologising for his recent inaccuracies, he immediately plunges into new ones.

Firstly, he speaks of 1·047 square feet as necessary for each operator, arriving at that figure by dividing the area by the number of operators he (erroneously) assumes requisite. But why measure the operators' space in square feet.

The operators do not sit *on* the board, but *at* the table, and the space they require is not included in the measurement of the apparatus itself. Then, after assuming that 100 operators are necessary, and assigning them 1·047 square feet each, he straightway uses them up by putting 44 on each side, and one at each end, making 90 in all. The remaining 10 vanish into space. As a matter of fact, the number of operators required to work the table is neither 100 or 90, but 50.

My strictures apply to the first five paragraphs of Mr. Miller's interesting letter only. I agree with his other statements, viz.:—(1) That the adoption of the Mann system at one end only of a trunk will yield a quicker service than would be obtained if neither end possessed it, and involves no practical difficulties: (2) that the call wire system introduced into India was the Law, not the Mann; (3) that the Law is no good practically; (4) that the abolished call wire systems have always been the Law, with one exception only, and in that case it was soon discovered that a great blunder had been made, for which its unfortunate author was held responsible; (5) that Mr. Miller's modification is an improvement, and was not anticipated in America; if it is remembered that the Law circuit has a metallic loop never put to earth, while the Mann has a branch to earth at every subscriber's office, it will be evident that the circular loop of the Law has nothing in common with Mann's; (6) that the

Mann system supplies an incomparably better service than any other, Post Office not excepted.

Mr. Miller's long practical experience entitles his opinion to respect, and it will be seen that he confirms these points to the full, which are some of the most important features in the matter under criticism.

F. F. Bennett.

I should be glad if you would permit me to make a few remarks on Mr. Poole's letter, which you published last week. From my former letter it will have been seen that the space occupied by the 100 jacks he mentions and 100 of the Western Electric jacks is practically the same. A model switchboard has been constructed and approved, using the same size jacks, and having a capacity of 10,500. On the question of capacity I should like to say that Mr. Poole cannot claim for a horizontal board a minimum repetition of jacks and a large ultimate capacity as well. A vertical switchboard with indicators will afford an operator access to a very much larger number of jacks of the same size than would be possible with a horizontal board without indicators.

Mr. Poole's remark that he is "the inventor of the system adopted at the National Telephone Company's Manchester exchange, which is generally looked upon as a model exchange in this country," may, I fear, be misinterpreted. Mr. Poole, no doubt, refers to the system of calling and disconnecting, which is singular to Manchester; but the Western Electric Company are the inventors and manufacturers of the apparatus used in the exchange, and it is, I think, in respect of this apparatus, combined with the advantages which the switch-room itself offers, that it has been looked upon as a model.

As so many of your correspondents have referred to the Western Electric boards, I should like to add that the multiple system of switching is quite independent of the means of calling. Indicators are supplied, and the boards are made upright simply because those methods are preferred, but the switching apparatus can be used without indicators, and can be placed either vertically or horizontally, as may be desired.

J. E. Kingsbury.

October 26th, 1891.

Kindly allow me a little space for a few further remarks on the above subject.

Mr. Miller is mistaken in regard to the law (?) he mentions in his last not having been previously pointed out. It is one well known by practical telephonists in connection with *non-multiple* switchboards, and was referred to in your pages at the beginning of this year in a correspondence on the subject of switchboards. For a multiple board it is simply a matter of multipling or repeating the subscribers' jacks a sufficient number of times to allow room for an adequate number of operators, and it is also necessary to keep the jacks small, in order that each operator may be able to reach the jacks of every subscriber. In this connection, I notice Mr. Kingsbury's statement that smaller spring-jacks are now used by his firm. Probably these will be similar in size to those used in a New York central switchboard, the ultimate capacity of which was to have been 10,000, but this, I have lately been informed, has been abandoned. The fact that they have brought out these small jacks shows that the W.E. Co. are alive to the importance of a reduction in size.

In referring to ring-off indicators, Mr. Miller might also have excepted my special one used since 1880 in the National Company's Manchester exchange, which allows subscribers to ring each others bells, and is only operated when desirable by a special press-button.

In regard to your note to Mr. Miller's letter, I rather think someone from over the herring pond will be able to inform you that the original "Law" exchange in New York was worked by call wires on the *series* system, and also without annunciators.

If an exchange of 600 to 1,000 subscribers does not represent telephony on a large scale, surely Mr. Goodwin must acknowledge the Paris exchange of nearly 10,000 loop lines to be such. Paris, however, appears to be ignored, as does also the confirmatory diagram of the return call wire given by Mr. Miller. Mr. Goodwin appears to have copied Mr. Bennett's diagram pretty closely, and as though to prove how little he knows of what he has been writing about, he speaks of all the several sections of the call wire or wires of his Indian exchange being connected at night to one *phone*. I pity the poor fellow who had to keep the phone to his ear all night. Things have always been managed much better than that in this country, a night *bell* being always connected.

J. Poole.

October 26th, 1891.

The correspondence that has appeared on this subject is, in my belief, one of the first importance, and I very much regret that you should indicate a desire to see it closed.

I speak the sentiments of a large circle who will be very much disappointed indeed if it is so abruptly terminated.

It is a pity the personal element has crept in, and I cannot but say that I think Mr. Bennett has had scant justice. However, would it not even now be possible to start afresh and invite the correspondents to renew it and avoid recrimination.

Whatever the merits of the system advocated by Mr. Bennett, it certainly is entitled to calm criticism, as I am at a loss to know of any name who has done more for telephony in this country.

As I am myself an old offender in this style of correspondence, I am sorry I cannot set myself up as an example; but you can afford to be magnanimous, and get this correspondence again on a proper footing.

A. Erskine Muirhead.

Glasgow, *October 27th*, 1891.

I omitted in my last letter to reply fully to that portion of Mr. Bennett's letter intended to hold me up to your readers as an outsider altogether. Mr. Bennett's intention in making such statements are so palpable that I thought it necessary to have all particulars on the subject. If my name does not appear on the *present* list of the Institution of Electrical Engineers, the fact still remains that on the 13th of December, 1876, I had the honour of being proposed by Mr. J. Sivewright, seconded by Mr. W. H. Preece and Mr. C. E. Spagnoletti, and subsequently admitted an Associate of the Society of Telegraph Engineers, now known as the Institution of Electrical Engineers. My subsequent resignation does not alter the facts that the following appears in the journal of this Institution, under the heading "Associates": Henry Goodwin, West India and Panama Telegraph Company, Basseterre, Guadeloupe, French West Indies. Curiously enough Mr. Bennett had the honour of being admitted into this society the same year. If the fact of being connected with this Institution constitutes him an authority on electrical matters, then I claim the same privilege.

Before concluding this letter I would like to thank Mr. Miller for his positive assurance that the system I worked in India was the *Law*; but I think after seeing my diagram he will not be quite so sure on this subject. I should have thought that a man who had had absolute charge of five exchanges in India, as I have had, would have been considered a greater authority than those who were thousands of miles away at the time, unless, owing to the fact that the work was in India, the Mahatmas were busy. I still maintain that it is too risky to make so many subscribers dependent upon even two call wires.

H. Goodwin.

October 26th, 1891.

[We are sorry that our correspondents have found a difficulty in complying with our suggestion that they should so word their letters as to make counter replies unnecessary, and have consequently rendered it impossible for us to close the correspondence this week. For their guidance, we may suggest that expressions of opinion are always open to counter opinion, whilst if they confine their observations to statements of facts, replies will be unnecessary.—Eds. Elec. Rev.]

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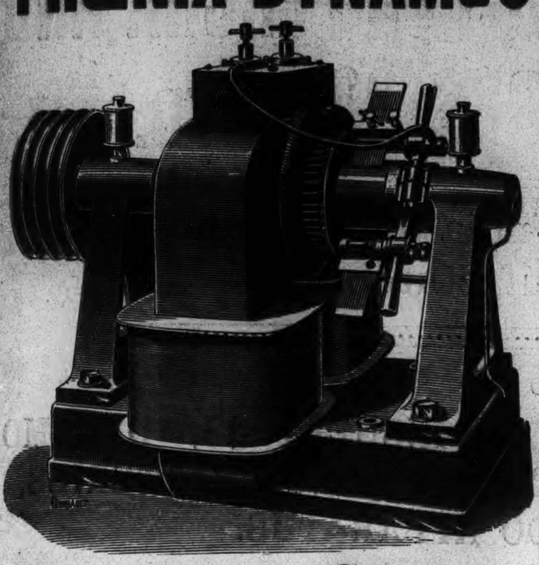

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4S	2,100	50 to 110	35	1,600	3½	38	3 0	3 10
5S	3,000	60 to 110	50	1,520	5	44	3 5	4 0
6S	4,500	60 to 110	75	1,480	7½	55	3 15	4 10
7S	6,000	60 to 120	100	1,360	10	65	4 5	5 0
8S	9,000	60 to 120	150	1,260	15	85	5 0	5 10
9S	12,000	60 to 120	200	1,180	20	105	6 0	6 0
10S	18,000	80 to 150	300	1,020	30	146	8 0	—
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8D	18,000	65 to 110	300	650	30	170	8 0
9D	24,000	65 to 110	400	600	40	220	10 0
10D	36,000	110 to 125	600	500	60	290	12 0
11D	48,000	110 to 125	800	450	80	375	14 0
12D	60,000	110 to 125	1,000	400	100	450	16 0

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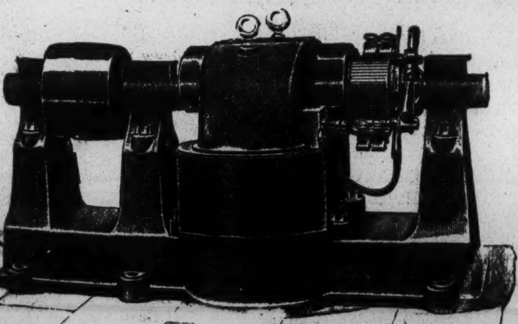

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